

A fluorescence microscopy image showing a dense population of cells. Many cells exhibit bright red fluorescence, while others show green fluorescence. Some cells appear to have both red and green signals. The background is dark, making the fluorescent cells stand out.

# Science

1 January 1999

Vol. 283 No. 5398  
Pages 1-132 \$8



AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



# STRATAGENE

## Building the Perfect Competent Cell

Stratagene has been building better competent cells for more than 10 years. We were first to break the transformation-efficiency barrier with our XL2-Blue ultracompetent cells. Large plasmid transformation is now possible because of our newly-discovered Hte phenotype, found in our revolutionary XL10-Gold™ strain. The Hte phenotype also increased the efficiency of our BL21-Gold derivatives, the best cells for protein expression. And for cloning unstable DNA, we designed the SURE® strain. Call us today and get more information on our complete line of innovative competent cells.

**Hte**

High transformation efficiency and large plasmid transformation

- XL10-Gold™ cells
- BL21-Gold cells and derivatives

**McrA-, McrCB- and Mrr-**  
Allows cloning of methylated DNA

- XL1-Blue MRF' cells
- XL2-Blue MRF' cells
- XL10-Gold™ cells
- SURE® cells

**EndA-**  
Provides high-quality miniprep DNA

- BL21-Gold cells and derivatives
- XL1-Blue cells
- XL2-Blue cells
- XL10-Gold™ cells
- SURE® cells

**RecA-**  
Eliminates general recombination

- XL1-Blue cells
- XL2-Blue cells
- XL10-Gold™ cells
- SURE® cells

**Dam- and Dcm-**  
Allows cleavage with methylation sensitive enzymes

- SCS110 cells
- JM110 cells

**UvrC-, UmuC-, SbcC-, RecB-, and RecJ-**  
Allows cloning of unstable DNA

- SURE® cells
- SURE®2 cells

**LacI**  
Allows inducible gene expression

- XL10-Gold™ cells
- XL1-Blue cells
- SURE® cells

**LacΔM15**  
Blue/White color screening

- XL10-Gold™ cells
- XL1-Blue cells
- SURE® cells

UNITED STATES AND CANADA:  
(800) 424-5444  
INTERNET MAIL:  
techservices@stratagene.com

STRATAGENE EUROPE:  
Austria: 01 7956 7036  
Germany: 069 9509 6197  
Switzerland: 01 800 9045  
United Kingdom: 01 713 651 056

FOR MORE INFORMATION:  
www.stratagene.com

Circle No. 18 on Readers' Service Card







## AMPLIFY GC-RICH TEMPLATES WITH EASE

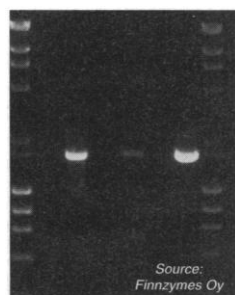
### ENZYME BLASTS THROUGH SECONDARY STRUCTURES

Some templates are difficult to amplify because they are GC-rich or contain long complementary areas that easily form loops. These secondary structures can prevent primer annealing and/or DNA synthesis, and thus they inhibit PCR and other amplification reactions.

DyNAzyme EXT is a particularly capable enzyme mix for driving amplification reactions in these tough circumstances. But sometimes, even EXT isn't enough. Fortunately, the enzyme is also tolerant of extra additives.

Often special "helping" solutions are employed to change the melting characteristics of

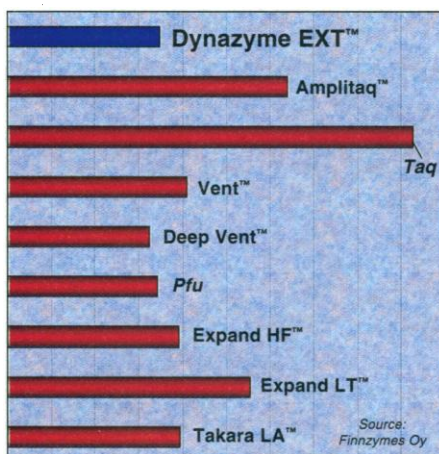
DNA and thus minimize the effects of secondary structure. These additives may be DMSO, formamide, glycerol, betaine, etc. EXT was tested alongside of two market-leading enzymes with and without their proprietary helping solutions. The result? Just look at the gel—DyNAzyme EXT with 5% DMSO (an ordinary lab reagent)



PCR on TGF-β1 1.9kb region (69% GC-rich)  
#1 "Q" taq, #2 "Q" taq + sol.  
#3 "C" taq, #4 "C" taq + sol.  
#5 EXT, #6 EXT + 5% DMSO

was significantly more effective in amplifying a 69% GC-rich template than either of the competing enzymes with their proprietary solutions.

## DyNAzyme EXT™ Polymerase Exhibits Extraordinary Fidelity



OD(450), lower signal means higher accuracy

### Fidelity Assayed in Actual PCR Reactions

The data above represent relative fidelity among a number of polymerases. It was collected using the immobilized mismatch binding protein method (IMBP)<sup>†</sup>. This technique, which detects errors through the binding of a repair protein, does not yield absolute numbers for error rates, but it is extremely effective in showing relative performance. It assays accuracy during actual PCR by measuring the number of accumulated errors in the final product, and it is able to detect almost all common mistakes. For more info, see [www.genecheck.com](http://www.genecheck.com).

<sup>†</sup>Wagner, R. & Dean, A. 1998. The use of immobilized mismatch binding protein for the optimization of PCR fidelity in "PCR Methods Manual," Innis M. Gelfand, D. and Smitsky, J. eds. in press

## BROAD TOLERANCE FOR VARYING REACTION CONDITIONS

### Get the Best of Both Worlds—Accuracy & Robust Reactions

WATERTOWN, Mass. — Since the spring of 1998, MJ RESEARCH has distributed the PCR-licensed DNA polymerases made by Finnzymes Oy of Finland. These enzymes have their origin in the thermophile *T. brockianus*, and they exhibit many superior properties to *Taq* polymerase in driving PCR reactions (especially in thermal stability and yield).

However, one question that was frequently asked is, "What's the fidelity compared to *Taq*?" Unfortunately, determining error rates is very laborious and condition dependent, and making comparisons among enzymes is not easily done. But now solid data exists—and the results are so good, the Finns insisted on repeating the experiments over and over again.

The assay used was IMBP (see accompanying article), and DyNAzyme EXT\* was particularly outstanding in its fidelity characteristics. EXT is a cocktail with a small amount of proofreading enzyme, and it is great for long PCR, high-fidelity TA cloning, and difficult templates. Yet in this fidelity assay, it performed as well or better than every other polymerase tested—including proofreading enzymes considered to be the "gold standards" of accuracy! But unlike those enzymes, EXT has the finesse to amplify templates as long as 40kb, the versatility to amplify templates that are high in GC content, as well as the robustness to withstand widely varying reaction conditions.

All DyNAzyme enzymes come licensed by Hoffmann-LaRoche to perform PCR reactions in research.\*\* DyNAzyme is available as native enzyme, recombinant enzyme, or as the EXT cocktail. All are available separately or in kits, and they come with a variety of buffers.

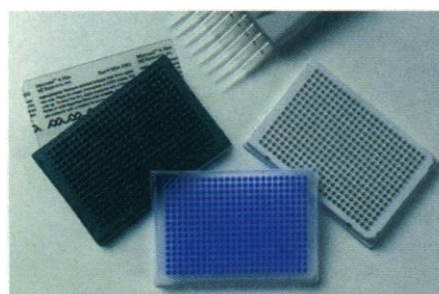
WEB: [WWW.MJR.COM](http://WWW.MJR.COM) • [WWW.FINNZYMES.FI](http://WWW.FINNZYMES.FI)

## 384-well Format Comes Into Its Own

### Plates Now Flatter & Bar Coded

MJ Research has been involved in the development of the 384-well format since 1993. In fact, the V-well design generally used in thermal cycling was developed by MJ engineers. It is a true 4x96-well configuration, which allows use of the same dispensing/harvesting equipment as with 96 wells (the frame is just shifted).

The newly improved Microseal 384 plate features a rigid, robot-friendly design with an industry-standard footprint and locator holes for secure handling. The flatter upper surface provides more reliable automated liquid dispensing, and the plates are much less likely to stick in the block after cycling. Serialized bar code labels (code39) are a new, low-cost option.



384-well plates of polypropylene plastic, now much improved for automated applications

\*EXT licensed under US Pat. 5,436,149 owned by TaKaRa Shuzo Co. Ltd.  
\*\* Purchase of DyNAzyme polymerase is accompanied by a limited license to use it in the Polymerase Chain Reaction (PCR) process for research in conjunction with a thermal cycler whose use in the automated performance of the PCR process is covered by the up-front license fee, either by payment to Perkin-Elmer or as purchased, i.e. an authorized thermal cycler.  
Trademarks: Amplitaq™ (Perkin-Elmer); Vent™, Deep Vent™ (New England Biolabs); Expand HF™, Expand LT™ (Boehringer Mannheim); Takara LA™ (Takara Shuzo)  
Circle No. 22 on Readers' Service Card



**MJ RESEARCH, INC.**

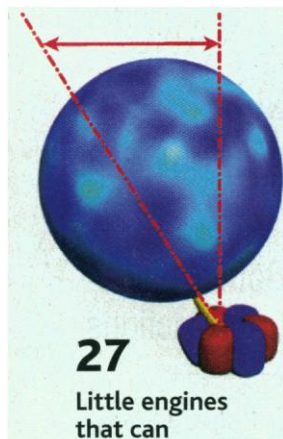
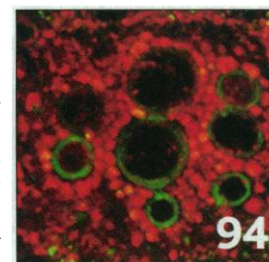
Manufacturer of Products for Molecular Biology

149 Grove St. • Watertown, MA 02472 USA  
(888) 729-2164 • Fax (617) 923-8080

# Science

www.sciencemag.org

**Cover** Localization of *CmPP16* messenger RNA (mRNA) in the vascular tissue of pumpkin plants (image width ~500  $\mu$ m). In this cross section of a petiole showing a vascular bundle, the green fluorescence identifies *CmPP16* mRNA within companion cells and sieve elements of the phloem. *CmPP16* has properties similar to plant viral movement proteins and appears to mediate mRNA entry into the phloem transport system. [Image: R. Ruiz-Medrano, B. Xoconostle-Cázares, W. J. Lucas]



27

Little engines that can

## DEPARTMENTS

NETWATCH  
7

THIS WEEK IN  
SCIENCE  
8

SCIENCESCOPE  
15

RANDOM SAMPLES  
31

CONTACT SCIENCE  
32

INFORMATION FOR  
CONTRIBUTORS  
99

NEW PRODUCTS  
101



AMERICAN  
ASSOCIATION FOR THE  
ADVANCEMENT OF  
SCIENCE

## NEWS

### NEWS OF THE WEEK

- ▼12  
94 **BIOLOGY: RNA Molecules May Carry Long-Distance Signals in Plants**
- 13 **HUMAN GENETICS: Iceland OKs Private Health Databank**
- 13 **ASTROPHYSICS: Has a Dark Particle Come to Light?**
- ▼14  
74 **NEUROBIOLOGY: Filling in the Blanks of the GABA<sub>A</sub> Receptor**
- 15 **PLANETARY SCIENCE: Moon-Forming Crash Is Likely in New Model**
- 16 **HUMAN CLONING: Korean Report Sparks Anger and Inquiry**
- ▼17  
83 **MOLECULAR BIOLOGY: DNA Chips Give New View of Classic Test**
- 18 **TOXICOLOGY: EPA Ponders Pesticide Tests in Humans**
- 19 **EUROPEAN SPACE AGENCY: Flat Budget Keeps Space Science on Edge**

19 **ASTROPHYSICS: Galaxies Seen at the Universe's Dawn**

21 **ASTROPHYSICS: Microwave Hump Reveals Flat Universe**

### NEWS FOCUS

22 **EXPANDING EU: Eastern Europe's Research Gamble**

Will the Euro Help Grants Flow?

SLOVENIA: Money and Mentors Hold Onto Young Researchers

CZECH/SLOVAK: Bringing Diverging Paths Back Together

U.S. AID: End of Joint Programs Leaves Researchers Feeling Jilted

27 **NANOTECHNOLOGY: Borrowing From Biology to Power the Petite**

28 **AMERICAN GEOPHYSICAL UNION: From Eastern Quakes to a Warming's Icy Clues**

## RESEARCH

### REPORTS

- 44 **Superionic and Metallic States of Water and Ammonia at Giant Planet Conditions**  
C. Cavazzoni, G. L. Chiarotti, S. Scandolo, E. Tosatti, M. Bernasconi, M. Parrinello
- ▼46  
41 **Liquid Morphologies on Structured Surfaces: From Microchannels to Microchips**  
57 H. Gau, S. Herminghaus, P. Lenz, R. Lipowsky
- ▼49  
42 **Sum Rules and Interlayer Conductivity of High- $T_c$  Cuprates**  
D. N. Basov, S. I. Woods, A. S. Katz, E. J. Singley, R. C. Dynes, M. Xu, D. G. Hinks, C. C. Homes, M. Strongin
- 52 **Imaging Electron Wave Functions of Quantized Energy Levels in Carbon Nanotubes**  
L. C. Venema, J. W. G. Wildöer, J. W. Janssen, S. J. Tans, H. L. J. Temminck Tuinstra, L. P. Kouwenhoven, C. Dekker
- 55 **DOAS Measurements of Tropospheric Bromine Oxide in Mid-Latitudes**  
K. Hebestreit, J. Stutz, D. Rosen, V. Matveiv, M. Peleg, M. Luria, U. Platt
- ▼57  
41 **Electrochemical Principles for Active Control of Liquids on Submillimeter Scales**  
46 B. S. Gallardo, V. K. Gupta, F. D. Eagerton, L. I. Jong, V. S. Craig, R. R. Shah, N. L. Abbott
- 61 **Quantum Statistical Corrections to Dynamic Nuclear Magnetic Resonance**  
L. J. Mueller and D. P. Weitekamp
- 65 **Chain Length Recognition: Core-Shell Supramolecular Assembly from Oppositely Charged Block Copolymers**  
A. Harada and K. Kataoka
- 67 **Requirement for Diverse, Low-Abundance Peptides in Positive Selection of T Cells**  
G. M. Barton and A. Y. Rudensky
- 70 **Blockade of NMDA Receptors and Apoptotic Neurodegeneration in the Developing Brain**  
C. Ikonomidou, F. Bosch, M. Miksa, P. Bittigau, J. Vöckler, K. Dikranian, T. I. Tenkova, V. Stefovská, L. Turski, J. W. Olney

SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Copyright © 1999 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): \$110 (\$62 allocated to subscription). Domestic institutional subscription (51 issues): \$325; Foreign postage extra: Mexico, Caribbean (surface mail) \$55; other countries (air assist delivery) \$90. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. Printed in the U.S.A.



EDITORIAL

32 Taking Inventory

LETTERS

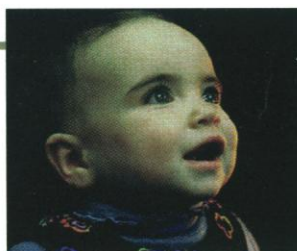
- 33 **Journal Economics** R. Johnson; D. L. Roth. **Miracle Heifer?** J. Ebeler. **What's in a "Midden"?** J. L. Modisette. **From Mice to Maize** C. Lawler and F. Erbsich. **Replacing Ancient Forests** D. W. Stahle. **Hominid Brain Volume** R. L. Holloway. **Response** G. C. Conroy, G. W. Weber, H. Seidler, P. V. Tobias. **Corrections and Clarifications**

POLICY FORUM

- 36 **MEDICINE: Effects of Medical Research on Health Care and the Economy** H. Pardes, K. G. Manton, E. S. Lander, H. Dennis Tolley, A. D. Ullian, H. Palmer

BOOKS ET AL.

- 38 **NATURE OF SCIENCE: *Unweaving the Rainbow Science, Delusion and the Appetite for Wonder*** R. Dawkins, reviewed by C. M. Vest



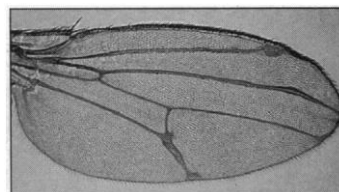
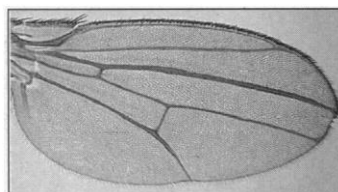
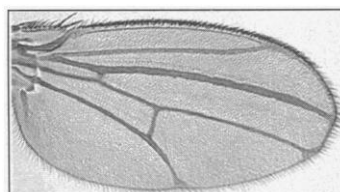
40

Learning by the rules

- 39 **EVOLUTION: *Darwinism Comes to America*** R. L. Numbers, reviewed by P. J. Bowler

PERSPECTIVES

- ▼40  
77 **COGNITION: Out of the Minds of Babes** S. Pinker
- ▼41  
46  
57 **SURFACE SCIENCE: Driven Liquids** M. Grunze
- ▼42  
49 **SUPERCONDUCTIVITY: Effective Mass and Color Change** M. V. Klein and G. Blumberg



91

Soluble Notch ligand

- ▼74  
14 **Role of Heteromer Formation in GABA<sub>B</sub> Receptor Function** R. Kuner, G. Köhr, S. Grünewald, G. Eisenhardt, A. Bach, H.-C. Kornau

- ▼77  
40 **Rule Learning by Seven-Month-Old Infants** G. F. Marcus, S. Vijayan, S. Bandi Rao, P. M. Vishton

- 80 **Assembly and Analysis of Conical Models for the HIV-1 Core** B. K. Ganser, S. Li, V. Y. Klishko, J. T. Finch, W. I. Sundquist

- ▼83  
17 **The Transcriptional Program in the Response of Human Fibroblasts to Serum** V. R. Iyer, M. B. Eisen, D. T. Ross, G. Schuler, T. Moore, J. C. F. Lee, J. M. Trent, L. M. Staudt, J. Hudson Jr., M. S. Boguski, D. Lashkari, D. Shalon, D. Botstein, P. O. Brown

- 88 **Regulated Delivery of Therapeutic Proteins After in Vivo Somatic Cell Gene Transfer** X. Ye, V. M. Rivera, P. Zoltick, F. Cerasoli Jr., M. A. Schnell, G.-p. Gao, J. V. Hughes, M. Gilman, J. M. Wilson

- 91 **Processing of the Notch Ligand Delta by the Metalloprotease Kuzbanian** H. Qi, M. D. Rand, X. Wu, N. Sestan, W. Wang, P. Rakic, T. Xu, S. Artavanis-Tsakonas

- ▼94  
12 **Plant Paralog to Viral Movement Protein that Potentiates Transport of mRNA into the Phloem** B. Xoconostle-Cázares, Y. Xiang, R. Ruiz-Medrano, H.-L. Wang, J. Monzer, B.-C. Yoo, K. C. McFarland, V. R. Franceschi, W. J. Lucas

TECHNICAL COMMENTS

- Gene Targeting in Human Cells Without Isogenic DNA** J. M. Sedivy, B. Vogelstein, H. L. Liber, E. A. Hendrickson, A. Rosmarin

[www.sciencemag.org/cgi/content/full/283/5398/9a](http://www.sciencemag.org/cgi/content/full/283/5398/9a)

- Endocranial Capacity of Early Hominids** C. A. Lockwood and W. H. Kimbel; J. Hawks and M. H. Wolpoff. **Response** G. C. Conroy, G. W. Weber, H. Seidler, P. V. Tobias

[www.sciencemag.org/cgi/content/full/283/5398/9b](http://www.sciencemag.org/cgi/content/full/283/5398/9b)

SCIENCE ONLINE  
[www.sciencemag.org](http://www.sciencemag.org)

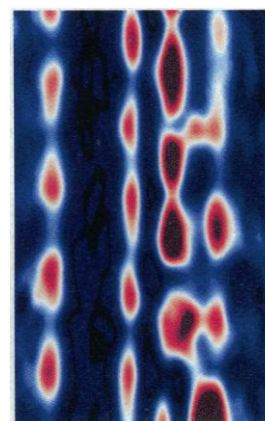
SCIENCE  
THE JOURNAL  
[www.sciencemag.org](http://www.sciencemag.org)

SCIENCENOW  
DAILY NEWS SERVICE  
[www.sciencenow.org](http://www.sciencenow.org)

NEXT WAVE  
WEEKLY CAREER UPDATES  
[www.nextwave.org](http://www.nextwave.org)

GRANTSNET  
RESEARCH FUNDING DATABASE  
[www.grantsnet.org](http://www.grantsnet.org)

NEUROAIDS  
EXPERIMENTAL WEB SITE  
[www.sciencemag.org/NAIDS](http://www.sciencemag.org/NAIDS)



52

Resolving discrete electron states in nanotubes

Change of address: allow 4 weeks, giving old and new addresses and 8-digit account number. Postmaster: Send change of address to *Science*, P.O. Box 1811, Danbury, CT 06813-1811. Single copy sales: \$8.00 per issue prepaid includes surface postage; bulk rates on request. Authorization to photocopy material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that \$4.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. The identification code for *Science* is 0036-8075/83 \$4.00. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

For protein purification you can rely on.

## HiPrep™ pre-packed columns

No: Carolina, 25, is not older than she looks. While others are still packing their purification columns, her customers are getting great results thanks to the new HiPrep range of pre-packed columns. Carolina draws on Amersham Pharmacia Biotech's 39 pioneering years in chromatography.\*

Her customers can count on consistent quality and guaranteed reliability every time.

By cutting out column packing time, HiPrep brings you two steps closer to the result in a convenient, elegant manner. With HiPrep columns, you can capture your protein and remove most of the impurities without delay.

And you don't need 39 years' experience to work out how good that could make you look.

Quick: find out more about HiPrep by visiting [www.apbiotech.com/hiprep](http://www.apbiotech.com/hiprep)

Or call us: in Europe +44 (0) 1494 544550; in the US 1-800 526 3593; in Japan +81 3 5331 9336; and from the rest of the world +44 (0) 1494 544100.

\*Gel filtration with Sephadex first appeared in Nature, 1959.

Of course  
you get great protein  
purification results.  
I've got 39 years'  
experience behind me.

Amersham Pharmacia Biotech UK Limited, Amersham Place, Little Chalfont, Buckinghamshire England HP7 9UA. All goods and services are sold subject to the terms and conditions of sale of the company within the Amersham Pharmacia Biotech group which supplies them. A copy of these terms and conditions of sale is available on request.

Carolina is one of our Production Engineers, and proud of the tough line she takes when it comes to quality lab media products. We aren't going to argue. She is also an expert in Jiu Jitsu.



amersham pharmacia biotech

Circle No. 14 on Readers' Service Card



# THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

microarray system to look at temporal changes in gene expression when quiescent human fibroblasts are exposed to serum. They find clustering of genes that suggests clues to function and a possible recapitulation of many of the steps of wound repair.

## DRUG PRODUCTION IN VIVO

Gene therapy will be most useful if the expression of the therapeutic proteins can be controlled and regulated. Ye *et al.* (p. 88) used an adeno-associated virus system in which erythropoietin expression is under the control of two chimeric proteins that are reconstituted in vivo into an inducible transcription factor complex. Stable, expression was observed in immune-competent mice for 6 months and in rhesus monkeys for 3 months.

## NOTCH ON THE MOVE

Throughout development, the Notch signaling pathway functions in directing cell fate, patterning, and morphogenesis. Previous work indicated that the Notch cell surface receptor is activated by direct cell contact with a ligand-expressing cell, with Notch forming a complex with transmembrane ligands such as Delta and Serrate.

Qi *et al.* (p. 91) used biochemical and genetic analyses to show that the metalloprotease Kuzbanian cleaves the Notch ligand and Delta. This work is contrary to previous models showing that Notch ligands act exclusively as membrane-bound molecules. Instead, the ligand can be found as an active diffusible ligand, possibly permitting Notch signaling that is not restricted to adjacent cells.

## PASSING RNA BETWEEN PLANT CELLS

Certain viruses spread through their infected host plants with the aid of virally encoded proteins that shepherd nucleic acids from one cell to the next through the plasmodesmata, channels connecting neighboring cells. Xoconostle-Cázares *et al.* (p. 94; see the cover and the news story by Strauss) show that the pumpkin plant encodes its own protein with similarities to these viral movement proteins. Thus, the marked mobility of viral components between cells may be a reflection of physiological processes already present, but perhaps regulated with more discrimination, in the normal plant. These processes may allow RNA molecules to be carried far from the cell that synthesized them.

## TECHNICAL COMMENT SUMMARIES

### Gene Targeting in Human Cells Without Isogenic DNA

The full text of this comment can be seen at [www.sciencemag.org/cgi/content/full/283/5398/9a](http://www.sciencemag.org/cgi/content/full/283/5398/9a)

"Because gene targeting in human somatic cells is rapidly gaining acceptance," J. M. Seidv *et al.* "have compiled gene targeting data available to date" to assess whether the procedure's success depends on the use of isogenic DNA, which would be a significant technical impediment. They found "numerous examples of high-efficiency gene targeting using nonisogenic DNA," and "thus envision the rapid emergence of a library of tested and optimized gene targeting vectors that will be available for widespread gene analysis in the large number of human experimental cell systems."

### Endocranial Capacity of Early Hominids

The full text of these comments can be seen at [www.sciencemag.org/cgi/content/full/283/5398/9b](http://www.sciencemag.org/cgi/content/full/283/5398/9b)

G. C. Conroy *et al.* (Reports, 12 June, p. 1730) used transaxial computed tomography (CT) scans to measure the endocranial capacity of an early hominid skull (Stw 505) from Sterkfontein, South Africa, tentatively assigned *Australopithecus africanus*. The capacity was estimated to be about 515 cubic centimeters, "markedly less than anecdotal reports of endocranial capacity exceeding 600 cubic centimeters."

C. A. Lockwood and W. H. Kimbel comment that not all "sources of postmortem distortion have been taken into account" and that the reported measure underestimates the actual capacity "perhaps by as much as 10 to 15%." J. Hawks and M. H. Wolpoff estimate endocranial volume "by stepwise multiple regression" with the use of "seven linear measurements" to arrive at a capacity of 598 cubic centimeters.

In response, Conroy *et al.* discuss how they accounted for "the obvious displacement of the left parietal-temporal bones" in their study. They state that several of the seven linear measurements used by Hawks and Wolpoff may well be "values that have been overestimated in the paleoanthropological literature and are themselves in need of reassessment" (see related Letters to the Editor, p. 34).

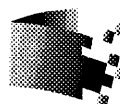
# Buried Treasure

Science-ONLINE

Science  
E-MARKETPLACE

Science  
E-MARKETPLACE

HOME HELP SEARCH ARCHIVE  
FEEDBACK ORDER



Science's  
Literature  
Library

Welcome to Literature Library, highlighting catalogs, brochures, technical applications sheets and more from leading scientific companies.

Look For Literature Information  
Using One Of These Indexes:

- ▶ Company Listing
- ▶ Category Listing:
  - ▶ Analytical Instruments
  - ▶ Antibodies and Assays
  - ▶ Biologicals
  - ▶ Cell Culture
  - ▶ Chromatography Systems and Supplies
  - ▶ DNA Sequencing/Fragment Analysis
  - ▶ DNA/RNA Amplification Systems
  - ▶ Image Analysis Instrumentation
  - ▶ Laboratory Supplies



[www.scienceonline.org](http://www.scienceonline.org)



E-MARKETPLACE



Literature  
Library



Science's  
Literature  
Library

[www.scienceonline.org](http://www.scienceonline.org)  
Click on E-MARKETPLACE,  
then click on Literature Library

EDITOR-IN-CHIEF  
**Floyd E. Bloom**

EDITOR  
**Ellis Rubinstein**

MANAGING EDITOR  
**Monica M. Bradford**

#### EDITORIAL

DEPUTY EDITORS Philip H. Abelson (*Engineering and Applied Sciences*); John I. Brauman (*Physical Sciences*); Thomas R. Cech (*Biological Sciences*)

SENIOR EDITORS Gilbert J. Chin, R. Brooks Hanson, Pamela J. Hines, Barbara Jasny, Paula A. Kiberstis, Linda J. Miller, L. Bryan Ray, Phillip D. Szuroni; ASSOCIATE EDITORS Beverly A. Purnell, Linda R. Rowan; EDITORIAL ASSISTANT Carolyn Kyle; MANUSCRIPT ASSISTANTS Candace Gallery, Amy Herda, Patricia M. Moore, Anita Wynt; ADMINISTRATIVE SUPPORT Sylvia Kihara

SCIENCE'S COMPASS: SENIOR EDITOR Katrina L. Kelner; ASSOCIATE BOOK REVIEW EDITOR Sherman J. Suter; CONTRIBUTING EDITORS David F. Voss, Kevin Ahern; ASSISTANTS Brent Gendelman, Jeffrey Hearn;

#### PUBLISHER

**Richard S. Nicholson**

ASSOCIATE PUBLISHER  
**Beth Rosner**

MEMBERSHIP/CIRCULATION DIRECTOR  
**Michael Spinella**

#### MEMBERSHIP/CIRCULATION

DEPUTY DIRECTOR Marlene Zendell

MEMBER SERVICES: MANAGER Michael Lung; SUPERVISOR Mary Curry; REPRESENTATIVES Laurie Baker, Pat Butler, Christine Ford, Mari Pope, Jantell Smith

MARKETING: MANAGER Scott Oser; COORDINATOR Lauri Sirois; EUROPE MANAGER Jane Pennington; ASSOCIATE Ruth Jackson  
RESEARCH: MANAGER Renuka Chander  
BUSINESS AND FINANCE: MANAGER Dwight Theall; ASSISTANT Susan Maxim; COMPUTER SPECIALIST Charles Munson

#### FINANCE AND ADVERTISING

BUSINESS AND FINANCE: BUSINESS MANAGER Deborah Rivera-Wienhold; SENIOR ANALYST Randy Yi; FINANCIAL ANALYST Lisa Donovan  
RIGHTS AND PERMISSIONS: ASSOCIATE Lincoln Richman; ASSISTANT Emilie David  
MARKETING: DIRECTOR John Meyers; ASSOCIATES Allison Pritchard, Chris Harbaugh  
ELECTRONIC MEDIA: MANAGER David Gillikin; COMPUTER SPECIALIST Wendy Green; PRODUCTION ASSOCIATES Mark Croatti, Ellen McGuire

#### INFORMATION SPECIALIST Janet Kegg

LETTERS AND TECHNICAL COMMENTS: EDITOR Christine Gilbert; ASSOCIATE EDITOR Steven S. Lapham; ASSISTANT Charlene King  
TECHSIGHT: CONTRIBUTING EDITORS Richard Peters, Robert Sikorski  
EDITING AND PROOFREADING: DIRECTOR Dawn McCoy; SUPERVISOR Cara Tate; SENIOR COPY EDITORS Cay Butler, Harry Jach, Barbara Ordway, Christine M. Pearce; COPY EDITORS: Jeffrey E. Cook, Etta Kavanagh, Jason Llewellyn, Joshua Marcy  
COPY DESK: Joi S. Granger, Monique Martineau, Ellen E. Murphy, Beverly Shields

#### NEWS

NEWS EDITOR Colin Norman; FEATURES EDITOR Tim Appenzeller; DEPUTY NEWS EDITORS Elizabeth Culotta (contributing editor), Jean Marx, Jeffrey Mervis, Richard Stone; NEWS WRITERS Michael Hagmann (intern), Constance Holden, Jocelyn Kaiser, Richard A. Kerr, David Kestenbaum, Andrew Lawler, David Malakoff, Eliot Marshall, Elizabeth Pennisi, Robert F. Service, Gretchen Vogel  
BUREAUS: BERKELEY, CA Marcia Barinaga (contributing correspondent); SAN DIEGO, CA Jon Cohen; CHICAGO, IL James Glanz; COPY EDITORS Linda B. Felaco, Daniel T. Helgerman; CONTRIBUTING CORRESPONDENTS Barry A. Cipra, Ann Gibbons, Charles C. Mann, Anne Simon Moffat, Virginia Morell, Evelyn Strauss, Gary Taubes, Ingrid Wickelgren; ADMINISTRATIVE SUPPORT Scherraine Mack, Fannie Groom

#### PRODUCTION

DIRECTOR James Landry; MANAGER Wendy K. Shank; ASSISTANT MANAGER Elizabeth A. Harman; ASSOCIATES Vicki J. Jorgensen, Tara L. Kelly, Jessica K. Moshell, Rebecca Thomas

#### PRODUCT ADVERTISING

NATIONAL SALES MANAGER NORTHEAST AND E. CANADA Richard Teeling: 973-904-9774, FAX 973-904-9701 • MIDWEST/ SOUTHEAST Elizabeth Mosko: 773-665-1150, FAX 773-665-2129 • WEST COAST/W. CANADA Neil Boylan: 415-673-9265, FAX 415-673-9267 • MID ATLANTIC AND U.S. INSIDE SALES Christopher Breslin: 202-326-6544, FAX 202-682-0816 • INTERNET SALES Laura Tellez 202-326-6599, FAX 202-682-0816 UK/SCANDINAVIA/France/ITALY/BELGIUM/NETHERLANDS Andrew Davies: (44) 7071-226-216, FAX (44) 7071-226-233 • GERMANY/SWITZERLAND/AUSTRIA Tracey Peers: (44) 1-260-297-530, FAX (44) 1-260-271-022 JAPAN Masuyoshi Yoshikawa: (81) 3-3235-5961, FAX (81) 3-3235-5852 • TRAFFIC MANAGER Carol Maddox; SALES ASSOCIATES Sheila Myers, Sandra Walls; ADMINISTRATIVE SUPPORT Jessica Tierney

#### RECRUITMENT ADVERTISING

SALES AND PRODUCTION OPERATIONS MANAGER Terri Seiter Azie U.S.: SALES MANAGER Gabrielle Boguslawski: 718-491-1607, FAX 202-289-6742; SALES SUPERVISOR Daryl Anderson; SALES REPRESENTATIVES Troy Benitez, Beth Dwyer, Bren Peters-Minnis, Kristin West-apher; ASSISTANTS Erika Bryant, Kathleen Clark; Christina Geiger  
PRODUCTION: SENIOR ASSOCIATE Jennifer Rankin; ASSOCIATE Elizabeth Lenox COPY EDITOR/PROOFREADER Chris Filiatreau U.K./EUROPE: SALES MANAGER Debbie Cummings; SALES EXECUTIVE Sabine Lenu; ASSISTANT Elisabeth Py: (44) 1-223-326-500, FAX (44) 1-223-326-532 AUSTRALIA/NEW ZEALAND: Keith Sandell: (61) 02-9922-2977, FAX (61) 02-9922-1100 JAPAN: Masuyoshi Yoshikawa: (81) 3-3235-5961, FAX (81) 3-3235-5852

#### BOARD OF REVIEWING EDITORS

Frederick W. Alt  
Children's Hospital, Boston  
Don L. Anderson  
California Institute of Technology  
Michael Ashburner  
University of Cambridge  
Frank S. Bates  
Univ. of Minnesota, Minneapolis  
Stephen J. Benkovic  
Pennsylvania State University  
Alan Bernstein  
Mount Sinai Hospital, Toronto  
Michael J. Bevan  
University of Washington, Seattle  
Seth Blair  
University of Wisconsin, Madison  
David E. Bloom  
Harvard Institute for  
International Development  
Piet Borst  
The Netherlands Cancer Institute  
Henry R. Bourne  
Univ. of California, San Francisco  
James J. Bull  
University of Texas at Austin  
Kathryn Calame  
Columbia Univ. College of  
Physicians & Surgeons  
Dennis W. Choi  
Washington Univ. School of  
Medicine, St. Louis  
Joanne Chory  
The Salk Institute  
David Clapham  
Children's Hospital, Boston

Adrienne E. Clarke  
University of Melbourne, Parkville  
F. Fleming Crim  
University of Wisconsin, Madison  
Paul J. Crutzen  
Max-Planck-Institut für Chemie  
James E. Dahlberg  
University of Wisconsin Medical  
School, Madison  
Robert Deslmones  
National Institute of Mental  
Health, NIH  
Hans Eklund  
Swedish Univ. of Agricultural  
Sciences, Uppsala  
Paul T. Englund  
Johns Hopkins University  
School of Medicine  
G. Ertl  
Max-Planck-Gesellschaft  
Richard G. Fairbanks  
Lamont-Doherty Earth  
Observatory  
Douglas T. Fearon  
University of Cambridge  
Harry A. Fozzard  
The University of Chicago  
Roger I. M. Glass  
Centers for Disease Control  
Peter N. Goodfellow  
SmithKline Beecham, UK  
Jack F. Greenblatt  
University of Toronto  
Peter Gruss  
Max Planck Institute of  
Biophysical Chemistry

Philip C. Hanawalt  
Stanford University  
Paul Harvey  
University of Oxford  
M. P. Hassell  
Imperial College at Silwood Park  
Nobutaka Hirokawa  
University of Tokyo  
Tomas Hökfelt  
Karolinska Institutet  
Tasuku Honjo  
Kyoto University  
Susan D. Iversen  
University of Oxford  
Eric F. Johnson  
The Scripps Research Institute  
Hans Kende  
Michigan State University  
Ellis Kiehl  
Harvard University  
Jeffrey T. Kiehl  
National Center for Atmospheric  
Research, Boulder  
Judith Kimble  
University of Wisconsin, Madison  
Stephen M. Kosslyn  
Harvard University  
Michael LaBarbera  
The University of Chicago  
Antonio Lanzavecchia  
Basil Institute for Immunology  
Nicole Le Douarin  
Institut d'Embryologie Cellulaire  
et Moléculaire du CNRS  
Norman L. Letvin  
Beth Israel Hospital, Boston

Harvey F. Lodish  
Whitehead Institute for  
Biomedical Research  
Richard Losick  
Harvard University  
Seth Marder  
California Institute of  
Technology  
Diane Mathis  
Institut de Chimie Biologique,  
Strasbourg  
Susan K. McConnell  
Stanford University  
Anthony R. Means  
Duke University Medical  
Center  
Stanley Meisel  
University of California, Davis  
Douglas A. Melton  
Harvard University  
Andrew Murray  
Univ. of California, San Francisco  
Elizabeth G. Nabel  
The Univ. of Michigan Medical  
Center  
Shigetada Nakanishi  
Kyoto University  
Kim Nasmyth  
Research Institute of  
Molecular Pathology, Vienna  
Roger A. Nicoll  
Univ. of California, San Francisco  
Staffan Normark  
Swedish Institute for Infectious  
Disease Control  
Kiyotaka Okada  
Kyoto University

Bert W. O'Malley  
Baylor College of Medicine  
Roy R. Parker  
University of Arizona, Tucson  
Stuart L. Pimm  
The Univ. of Tennessee, Knoxville  
Yeshayahu Pocker  
Univ. of Washington, Seattle  
Martin Raff  
University College London  
Douglas C. Rees  
California Institute of Technology  
T. M. Rice  
ETH-Hönggerberg, Zürich  
David C. Rubie  
Universität Bayreuth  
Erkki Ruoslahti  
The Burnham Institute, CA  
Gottfried Schatz  
Biozentrum, Basel  
Jozsef Schell  
Max-Planck-Institut für  
Zuchtforschung  
Ronald H. Schwartz  
National Institute of Allergy  
and Infectious Diseases, NIH  
Terrence J. Sejnowski  
The Salk Institute  
Christopher R. Somerville  
Carnegie Institute of Washing-  
ton, Stanford, CA  
Michael P. Stryker  
Univ. of California, San Francisco  
Cliff Tabin  
Harvard Medical School  
John Jen Tal  
National Taiwan University

#### ART

DESIGN DIRECTOR Amy Decker Henry; ART DIRECTOR C. Faber Smith; ASSOCIATE ART DIRECTOR Elizabeth Carroll; SCIENTIFIC ILLUSTRATOR Katharine Sutliff; GRAPHICS ASSOCIATES Holly Bishop, Preston Morrighan, Darcel Pugh, Patricia M. Riehn; PHOTO RESEARCHER Leslie Blizard

#### SCIENCE INTERNATIONAL EUROPE

EDITORIAL: OFFICE HEAD AND SENIOR EDITOR Richard B. Gallagher; ASSOCIATE EDITORS Stella M. Hurtley, Ian S. Osborne, Peter Stern, Julia Uppenbrink; EDITORIAL ASSOCIATE Belinda Holden  
NEWS: EDITOR Daniel Clery; CONTRIBUTING CORRESPONDENTS Michael Balter (Paris); Robert Koenig (Bern); UK EDITOR, SCIENCE'S NEXT WAVE John MacFarlane; ADMINISTRATIVE SUPPORT Janet Mumford, Liz Ellis

#### ASIA

JAPAN NEWS BUREAU: Dennis Normile (contributing correspondent); CHINA REPRESENTATIVE Hao Xin; INDIA CORRESPONDENT Pallava Bagla (contributing)

#### SCIENCE NOW: www.sciencenow.org

EDITOR Erik Stokstad

#### SCIENCE'S NEXT WAVE: www.nextwave.org

MANAGING EDITOR Wendy Yee; SENIOR EDITOR Nicole Ruediger WRITER Melissa Merti; CANADA EDITOR Charles Boulakia; ASSISTANT Suzanne Moore

#### AAAS BOARD OF DIRECTORS

RETIRING PRESIDENT, CHAIR Mildred S. Dresselhaus  
PRESIDENT M. R. C. Greenwood  
PRESIDENT-ELECT Stephen Jay Gould  
TREASURER William T. Golden  
EXECUTIVE OFFICER Richard S. Nicholson

Robert D. Goldman; Alice S. Huang; Sheila Jasanoff; Sally Gregory Kohlstedt; Marcia C. Linn; Michael J. Novacek; Neena B. Schwartz; Jean E. Taylor

Published by the American Association for the Advancement of Science (AAAS). Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in Science—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

Tomoyuki Takahashi  
University of Tokyo  
Masatoshi Takeichi  
Kyoto University  
Keiji Tanaka  
RIKEN Institute  
David Tilman  
Univ. of Minnesota, St. Paul  
Robert T. N. Tjian  
Univ. of California, Berkeley  
Yoshinori Tokura  
University of Tokyo  
Derek van der Kooy  
University of Toronto  
Geerat J. Vermeij  
University of California, Davis  
Bert Vogelstein  
Johns Hopkins Oncology  
Center  
Gerhard Wegner  
Max-Planck-Institut für  
Polymerforschung  
Arthur Weiss  
Univ. of California, San Francisco  
Zena Werb  
Univ. of California, San Francisco  
George M. Whitesides  
Harvard University  
Ian A. Wilson  
The Scripps Research Institute  
Alan P. Wolfe  
National Institute of  
Child Health and Human  
Development, NIH  
Martin Zatz  
National Institute of Mental  
Health, NIH





Plate: Image of NIH 3T3 transfected with green fluorescent protein (GFP).  
Background: CHO-K1 transfected with  $\beta$ -Gal plasmid.

## Finally, a transfection reagent that makes you smile, every time!

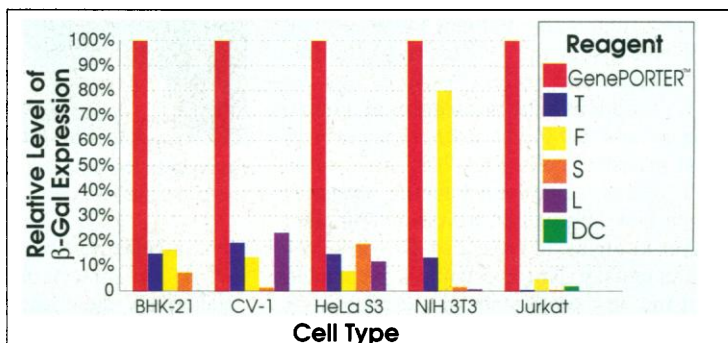
Introducing

### GenePORTER™ Transfection Reagent\*

GenePORTER™ reagent, which incorporates direct hydrophilic conjugation (DHC) technology\*, is the latest innovation from the lab of Dr. Philip Felgner, inventor of lipofection. We at Gene Therapy Systems are so confident as to the performance of our product, we stand behind it with a double-your-satisfaction guarantee\* on cell types listed. In a variety of cell lines, GenePORTER reagent consistently delivers higher levels of transfection than any other commercially available product. Without compromising transfection efficiency, this robust reagent performs in a wide range of conditions, including different ratios of plasmid and reagent. GenePORTER reagent is easy to use and does not require enhancers or special handling of cells, saving time, cost, and reagents. Order GenePORTER reagent today. The results will make you smile.

**GenePORTER™**  
Transfection  
Reagent

75 reactions • T201007  
150 reactions • T201015  
750 reactions • T201075



The  $\beta$ -Gal encoding plasmid was delivered into cells using GenePORTER and competitor's transfection reagents. Each manufacturer's protocol was followed.  $\beta$ -Gal expression was measured 48 hours after transfection by a colorimetric assay.

#### Transfected Cell Types†

HeLa S3	BHK-21
293	CHO-K1
Jurkat	CV-1
NIH 3T3	COS-1
B16-F0	COS-7
PC-12	

\* Patents pending.

† If you do not get better transfection results following our protocol, kit purchase price will be refunded or double-the-kit price will be applied to your GTS, Inc. account toward future purchases. Offer valid in USA only and ends 1/31/99. Guarantee is limited to cell types in this ad. The purchased GenePORTER reagent must be returned using the GTS, Inc. return policy. This offer is limited to one T201007 or T201015 kit per customer.

Circle No. 17 on Readers' Service Card



To Order: 888-428-0558

Fax: 619-587-1499

10190 Telesis Court  
San Diego, CA 92121, USA

For the complete product list  
check out the GTS Website @

<http://www.genetherapysystems.com>

#### GTS International Distributors

Australia • ASTRAL +61-2-9540-2055 Austria • BIO-TRADE +43 1 889 18 19  
Denmark, Finland, Norway, Sweden • KEBO Lab +46 8 621 35 07 France •  
OZYME +1 30 85 92 92 Germany • Biozym Diagnostik GmbH +49 5152-9020  
Japan, Rep. of China, Korea • Takara +81-77-543-7231 Switzerland • Axon  
Lab AG +41 56 484 80 80 Taiwan • PROtech, Ltd. 886-2-23810844 Takara  
+81-77-543-7231 United Kingdom • Lifescreen LTD. +44 0 1923 241515



[Chemdex] Welcome  
Location: <http://www.chemdex.com/>



**chemdex.com**

Search less. Discover more.

# Research —



With  
Less  
**Search.**

**Purchase Your Biological and Chemical Reagents.**

**Faster. Easier. Online.**

Search less to find the reagents you need  
and discover more of what you're looking  
for—at [chemdex.com](http://chemdex.com). Register for a free  
password today and experience the future.

[www.chemdex.com](http://www.chemdex.com)



**chemdex.com**

Search less.  
Discover more.

© 1998 Chemdex Corporation.  
Chemdex is a registered trademark of Chemdex Corporation.

Circle No. 10 on Readers' Service Card





# outstanding

## in Sequence Analysis

**NEW IN VERSION 10**

- More sensitive database searching (BLAST 2.0, SSearch)
- Motif identification with MEME
- ABI trace support
- Faster analysis with parallel code
- Year 2000 compliance

### Choose the standard: GCG®

Used by over 30,000 scientists at more than 600 institutions worldwide, the GCG Wisconsin Package™ is the sequence analysis package of choice. Scientists choose the proven technology of the Wisconsin Package for its:

### Breadth of Analysis

Only the Wisconsin Package offers you the power and flexibility to choose from so many analyses:

- database searching
- sequence comparison
- pattern searching
- primer selection
- sequence assembly
- protein analysis
- evolutionary analysis
- secondary structure prediction

### Strength in Database Access

Proprietary in-house data as well as purchased databases can be formatted for accessibility in GCG or FastA formats. Databases included with the software are:

- GenBank
- SWISS-PROT™
- REBASE
- EMBL
- PIR
- SP-TREMBL

The GENESEQ™ patent sequence database is available separately from GCG or Oxford Molecular.

The convenience and accuracy of bimonthly updates to the public databases are available from GCG for an additional fee.

### Ease of Use

Choose from three optional interfaces:

**SeqLab®.** Based on X Windows, SeqLab provides superior sequence and feature editing and annotation.

**SeqWeb®.** Use your web browser to analyze data on your desktop. Analysis results contain links to sequence resources in the databases and on the web.

**Batch.** Scriptable command lines provide the ability to do repetitive and numerous analyses.

### Extendible Framework

Extensions enable you to join in-house, third-party software, such as CLUSTAL W, WU-BLAST, SPS SWAT™, SPS Cross-Match™, and SPS Phrap™ within SeqLab to provide a common interface and easy access to all users.

For more information about Oxford Molecular products:

tel: 1-800-876-9994

<http://www.oxmol.com/prods/bio>

e-mail: [products@oxmol.com](mailto:products@oxmol.com)



For more information about GCG products:

tel: (608) 231-5200

<http://www.gcg.com/framework>

e-mail: [framework@gcg.com](mailto:framework@gcg.com)

Circle No. 12 on Readers' Service Card

Genetics Computer Group is a wholly owned subsidiary of Oxford Molecular Group, Inc. GCG, GCG logo, and Wisconsin Package are trademarks of Genetics Computer Group. Oxford Molecular and Oxford Molecular logo are trademarks of Oxford Molecular Ltd. All other product names mentioned may be trademarks or registered trademarks of their respective holders and are used for identification purposes only.