Representatives of diverse species from the plant kingdom. The genomes of thale cress (Arabidopsis thaliana), grape (Vitis vinifera), rice (Oryza sativa), and the moss Physcomitrella patens have been sequenced, and there is ongoing genetic research on apple (Malus domestica), rose (Rosa spp.), tomato (Solanum lycopersicum), Gerbera daisy (Gerbera hybridra), monkey flower (Mimulus lewisii), columbine (Aquilegia formosa), maize (Zea mays), wheat (Triticum aestivum), tulip poplar (Liriodendron tulipifera), and the fern Ceratopteris richardii. The special section beginning on page 465 includes News stories and Perspectives exploring plant biology, ecology, economic applications, and the future of plant genomics research.

Photo illustration: Kelly Krause/Science (images: Jupiter Images, Getty Images, USDA, Oregon State University)

Special Section

Plant Genomes

Introduction
Green Genes

News
GM Crops: A World View
466
Tough Lessons From Golden Rice
468
GM Papaya Takes on Ringspot Virus and Wins
472
Is the Drought Over for Pharming?
473
Uncorking the Grape Genome
475
A Life With Grapes
Sowing the Seeds for High-Energy Plants
478

Perspectives
Genome-Enabled Approaches Shed New Light on Plant Metabolism
479
D. DellaPenna and R. L. Last
Genomic Plasticity and the Diversity of Polyploid Plants
481
A. R. Leitch and I. J. Leitch
Selection on Major Components of Angiosperm Genomes
484
B. S. Gaut and J. Ross-Ibarra
Synteny and Collinearity in Plant Genomes
486
H. Tang et al.
The Epigenetic Landscape of Plants
489
X. Zhang
Extending Genomics to Natural Communities and Ecosystems
492
T. G. Whitham et al.
From Genotype to Phenotype: Systems Biology Meets Natural Variation
495
P. N. Benfey and T. Mitchell-Olds

News of the Week
New Superconductors Propel Chinese Physicists to Forefront
432
When Hobbits (Slowly) Walked the Earth
433
Two Geologic Clocks Finally Keeping the Same Time
434
>> Research Article p. 500
Sciencescope
Europe Takes Guesswork Out of Site Selection
436
Rebuilding the Injured Warrior
437
News Focus
Bypassing Medicine to Treat Diabetes
438
Japanese Experts Steal a Glance at Once-Taboo Royal Tomb
441
Pardis Sabeti: Picking Up Evolution’s Beat
442
A Renowned Field Station Rises From the Ashes
444

Science Online
This Week in Science
Editors’ Choice
Contact Science
Random Samples
Newsmakers
AAAS News & Notes
New Products
Science Careers

Cover

Representatives of diverse species from the plant kingdom.
CLIMATE CHANGE

The Sensitivity of Polar Ozone Depletion to Proposed Geoengineering Schemes
S. Tilmes, R. Müller, R. Salawitch
Calculations imply that injection of sulfur into the atmosphere to counteract global warming would threaten the ozone layer, as occurred after the Mount Pinatubo eruption.
10.1126/science.1153966

IMMUNOLOGY

Coordination of Early Protective Immunity to Viral Infection by Regulatory T Cells
J. M. Lund, L. Hsing, T. T. Pham, A. Y. Rudensky
In mice infected with herpes virus, an usually immunosuppressive T cell is necessary for rapid arrival of immune cells and elevated cytokine levels at the site of infection.
10.1126/science.1155209

PLANT SCIENCE

Cell Identity Mediates the Response of Arabidopsis Roots to Abiotic Stress
J. R. Dinneny et al.
In Arabidopsis root tips exposed to high salinity or iron deficiency, clusters of genes are induced that are unique to one or both of these stress responses.
>> Plant Genomes section p. 465
10.1126/science.1153795

PLANT SCIENCE

Genome-Scale Proteomics Reveals Arabidopsis thaliana Gene Models and Proteome Dynamics
K. Baerenfaller et al.
The Arabidopsis proteome shifts as the plant develops, and proteins not predicted from genome analysis, some derived from introns and pseudogenes, are expressed.
>> Plant Genomes section p. 465
10.1126/science.1157956

BOOKS ET AL.

Fruits and Plains The Horticultural Transformation of America P. J. Pauly, reviewed by S. Kingsland
449

Most Dangerous Catch D. Elisco, Director;
450
FLOW: For Love of Water I. Salina, Director;
Building the Future—Energy N. Brown, Director;
Gimme Green I. Brown and E. Flagg, Directors;

POLICY FORUM

Harvesting Data from Genetically Engineered Crops
M. Marvier et al.
452

EDUCATION FORUM

The Advantage of Abstract Examples in Learning Math
J. A. Kaminski, V. M. Sloutsky, A. F. Heckler
454

PERSPECTIVES

Enigmas of Blood Clot Elasticity
J. W. Weisel
456

Identifying Ancient Asteroids
T. H. Burbine >> Report p. 514
457

A One-Sided Signal
G. D. Fain and S. Grinstein >> Reports pp. 528 and 531
458

Carbon Crucible
M. Marquis and P. Tans
460

RNA Metabolism and Oncogenesis
D. L. Johnson and S. A. S. Johnson
461

BREVIA

PALEONTOLOGY

Molecular Phylogenetics of Mastodon and Tyrannosaurus rex
C. L. Organ et al.
Phylogenetic analyses of collagen protein fragments from fossils and 21 extant organisms group mastodons with elephants and Tyrannosaurus rex with birds.
499

RESEARCH ARTICLE

GEOCHEMISTRY

Synchronizing Rock Clocks of Earth History
K. F. Kuiper et al.
Tying an argon-argon dating standard to a section dated with Earth’s orbital variations yields older ages for the standard and for other events, including the K-T boundary. >> News story p. 434
500

REPORTS

MATERIALS SCIENCE

Sign Change of Poisson’s Ratio for Carbon Nanotube Sheets
L. J. Hall et al.
When stretched, a sheet made of carbon nanotubes contracts or expands in the opposite direction, depending on how many multiwalled tubes form zig-zag networks.
504
MATERIALS SCIENCE

Stretchable and Foldable Silicon Integrated Circuits 507
D.-H. Kim et al.
High-performance, bendable, and stretchable electronic devices are fabricated on an elastic plastic substrate by placing the critical electronic components in the neutral bending plane.

APPLIED PHYSICS

Near-Field Plates: Subdiffraction Focusing with Patterned Surfaces 511
A. Gribic, L. Jiang, R. Merlin
A grating near the focal plane can focus microwave radiation to a spot size well below the diffraction limit.

PLANETARY SCIENCE

Ancient Asteroids Enriched in Refractory Inclusions 514
J. M. Sunshine et al.
Spectral data imply that some asteroids contain higher concentrations of early solar system grains and materials than are found in any sampled meteorite. >> Perspective p. 457

CLIMATE CHANGE

Human-Induced Arctic Moistening 518
S.-K. Min, X. Zhang, F. Zwiers
Comparison of 22 climate models to observations show that human activity has increased precipitation in the Arctic over the past 50 years, altering its timing and distribution.

BIOCHEMISTRY

Efficient Inhibition of the Alzheimer’s Disease 520
β-Secretase by Membrane Targeting L. Rajendran et al.
Tethering an inhibitor to a membrane anchor renders it effective against a membrane enzyme that creates the amyloid fragments deposited in Alzheimer’s disease, even in vivo.

MEDICINE

Plastin 3 Is a Protective Modifier of Autosomal Recessive Spinal Muscular Atrophy 524
G. E. Oprea et al.
Expression of a protein that promotes axonal growth can compensate for the gene deletion in spinal muscular atrophy, indicating that axonal growth deficiencies cause the disease.

CELL BIOLOGY

Role of C. elegans TAT-1 Protein in Maintaining Plasma Membrane Phosphatidylserine Asymmetry 528
M. Darland-Ransom et al.
A phospholipid translocase enzyme keeps a critical membrane lipid localized to the inner leaflet of the cell membrane so it does not trigger engulfment by immune cells. >> Perspective p. 458; Report p. 531

Virology

Vaccinia Virus Uses Macropinocytosis and Apoptotic Mimicry to Enter Host Cells 531
J. Mercer and A. Helenius
To infect host cells, vaccinia virus exposes phosphatidylserine on its surfaces, which signals host cells to recognize the virus as cellular debris and take it up for clearance.

CELL BIOLOGY

Encoding Gender and Individual Information in the Mouse Vomeronasal Organ 535
J. He, L. Ma, S. Kim, J. Nakai, C. R. Yu
Mice can recognize the pheromones from individual mice through unique patterns of receptor activation in the vomeronasal organ.

EVOLUTION

Metabolic Diversification—Independent Assembly of Operon-Like Gene Clusters in Different Plants 543
B. Field and A. E. Osbourn
Through strong selection, similar clusters of genes for triterpene biosynthesis have arisen independently through gene duplication and neofunctionalization in several plant lines.

GENETICS

Mechanism of Self-Sterility in a Hermaphroditic Chordate 548
Y. Harada et al.
The sea squirt prevents self-fertilization with two genetic loci, each of which encodes a tightly linked sperm-egg receptor-ligand pair, a system similar to that of flowering plants.
PERSPECTIVE: Notch Signaling in Osteoblasts
E. Canalis
Notch signaling plays a role in bone remodeling by inhibiting the differentiation of osteoblasts and osteoclasts.

PERSPECTIVE: Back from the Dormant Stage—Second Messenger Cyclic ADP-Ribose Essential for Toxoplasma gondii Pathogenicity
A. H. Guse
The protozoan parasite T. gondii uses a plant-like signaling pathway to exit host cells.