sive dissociation, an absorbing layer that removes the kinetic energy of the ion, no charge transfer, and no chemisorption that could lead to dissociation. The group at Purdue has reached this goal in a remarkable way (*2*): The ion energy is kept low, which is experimentally very tedious, and to avoid chemisorption, the ions are trapped in a fluorocarbon self-assembled monolayer (F-SAM) on an Au substrate. To make sure that the molecules are stopped without hitting the substrate, bulky groups at the end of the molecules act as parachutes (see figure). The F-SAM monolayers have been demonstrated to be remarkably inert. Only when a molecule is locked between the molecules of the F-SAM is it trapped. No molecular deformation and no charge transfer occur. This combination makes it possible to softly land molecules intact at a surface. It is remarkable that the molecule retains even its charge in the layer. The only price one has to pay is that only molecules that are properly oriented can penetrate the chains of the F-SAM. This technique may indeed allow for an entirely novel way of storing information at the nanoscopic level.

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CELL BIOLOGY

Unresolvable Endings: Defective Telomeres and Failed Separation

R. Scott Hawley

In chess games and mystery novels, the focus is always on the end. A similar captivation with endings has directed the attention of generations of geneticists and cytologists to the ends of chromosomes, the telomeres. The question has always been, Just how are telomeres special, and what are their functions? Two reports (*1*, *2*), one on page 1478 of this issue (*1*), suggest a surprising new significance of telomeres in the processes of meiotic and mitotic chromosome segregation. Both reports point to an unexpected conclusion: Although telomeres themselves may not mediate chromosome segregation, the separation of telomeres during cell division creates a special problem for the segregational system.

The discovery of the structure of DNA, together with our understanding of how DNA replicates during the production of daughter cells, pointed to the first clear function for telomeres (*3*). Somehow, telomeres must facilitate the replication of the ends of the DNA molecule such that the chromosome does not shorten with each round of replication. Recall that DNA polymerase can only move in one direction (5′ to 3′). Thus, once the RNA primer on the leading strand at the end is removed, there is no way to "back-fill" the missing base pairs. Left unaltered, the next replication event will result in a daughter chromatid that has been shortened by a few base pairs (*4*).

Telomeres exist in at least two general forms, each of which appears to solve the problem of replicating chromosome ends in a different manner. In most organisms the telomere consists of tandemly repeated copies of a G-rich simple repeat sequence (for example, TTGGGG in *Tetrahymena thermophila*). The ends of the chromosome are prevented from shortening at each replication by the ability of an enzyme, called telomerase, to synthesize more such repeats at each end (*3*). This de novo synthesis of new telomeric repeats is mediated by a corresponding RNA template within the telomerase holoenzyme.

Curiously, *Drosophila melanogaster*, the organism in which telomeres were first discovered, possesses a very noncanonical telo-

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WEBWATCH

Electronic eruptions

http://volcano.und.nodak.edu/

At any one moment, dozens of volcanoes are active around the world. Volcano World is a prototype Web site supported by NASA to provide remote sensing data on volcanoes to a wide group of users. Data from a variety of sources are available, along with updates on currently active volcanoes, images of eruptions, and maps of volcanic regions. Educational material is the primary offering, with opportunities to learn how volcanoes work and submit questions to the volcanologists on the Web team. Links are also provided to the top volcano observatories and research centers.

Population ecology

http://www.gypsymoth.ento.vt.edu/~sharov/popechome/welcome.html

Groups of organisms that interact give rise to complex dynamical structures, and this is the domain of population ecology. Drawing together many resources, this site at Virginia Polytechnic Institute offers paths to computational models, journals, and online research papers. Extensive links to large data sets useful in ecological modeling are available, along with pointers to important simulations such as SmartForest at the University of Illinois. Links to related areas such as pest management and mathematics are also listed.

Material matters

http://vims.ncsu.edu/cgi/index.acgi

Hypertext is ideal for online textbooks. One of the best in materials science is ViMS, short for Visualizations in Materials Science, created at North Carolina State University. The site is a highly polished presentation of the syllabus of NCSU's introductory materials science course and is supplemented by more than 700 megabytes of downloadable movies, computer graphics, and simulations. Exercises for the student are available in Adobe PDF format and the contents of the site are available on CD-ROM.

Edited by David Voss

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