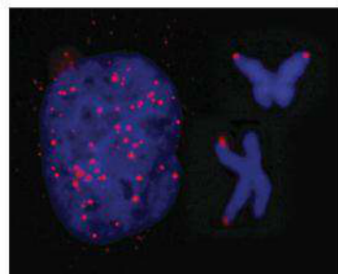


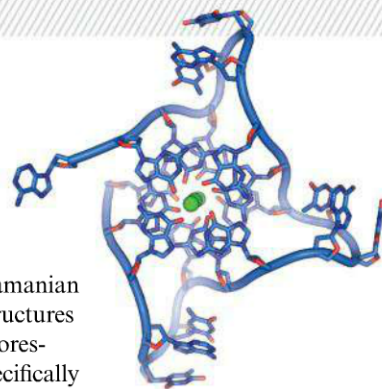
84 Four-Stranded DNA Makes Human Debut

→ In describing the two-stranded structure of DNA, Cambridge University biologists James Watson and Francis Crick gave us the image of a twisting ladder they called a double helix. The rungs were connected by pairs of chemical bases called nucleotides: Adenine (A) paired with thymine (T), and cytosine (C) with guanine (G). Now, 60 years later, researchers from the same institution have found a *quadruple* helix — previously described only in microorganisms — in human cells. In place of rungs, the twisting, four-sided tower has platforms with a guanine nucleotide on each of four corners, hence the name G-quadruplex.

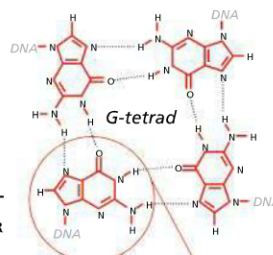
THE ANTIBODY used in the study, called BG4, binds with quadruple helices and glows red. The glowing structures are visible here in the nucleus of a human bone cancer cell (left) and on the telomeres at the ends of chromosomes in cervical cancer cells (right).



Chemist Shankar Balasubramanian and colleagues found the structures by engineering a special, fluorescent antibody that binds specifically to the four-stranded form. Initial results, published in January, trace the structures to cellular regions associated with explosive growth: telomeres, the protective caps of chromosomes implicated in aging and longevity, and cancer-causing genes. G-quadruplexes may be linked to cancer, speculates molecular biologist David Tannahill, a member of the Cambridge team. If his suspicion bears out, then deploying these antibodies, which halt the replication of the quads, could present a means of treating malignant tumors. — BREANNA DRAXLER

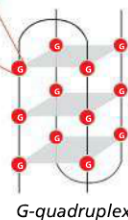


THIS TOP VIEW of a G-quadruplex shows its structure in the DNA of a human telomere, where they frequently form.



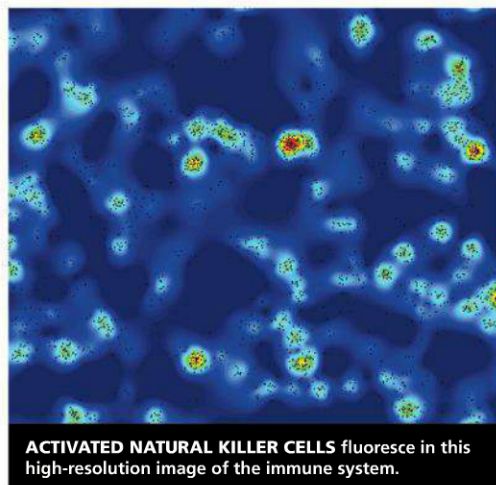
What's a G-Quadruplex?

The G-quadruplex (right) is like a three-dimensional tower with multiple floors. Each floor, called a tetrad, has a guanine (G) base on all four corners. These G's are held together with hydrogen bonds (depicted here by dotted lines). A single strand of DNA can fold onto itself to form a G-quadruplex, or guanines from multiple strands can bond to form a four-stranded structure, like the one at right.



85 Immune Attack Up Close

→ A microscope powerful enough to capture a single molecule has taken the clearest picture yet of the immune system in action. The technique, called superresolution single-molecule fluorescence microscopy, recently helped scientists at the University of Manchester in England track natural killer (NK) cells, which help destroy cancer and viruses. NK cells have receptors that are clustered together at their surface, and these receptors target proteins on another cell's surface to tell whether the contacting cell is diseased or healthy. When the NK cell is activated, the receptor clusters change in size and density, which could help NK cells recognize and eliminate infected cells — but spare healthy ones — next time around. — VALERIE ROSS



ACTIVATED NATURAL KILLER CELLS fluoresce in this high-resolution image of the immune system.

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Low-Tech Solutions for High-Stakes Problems

→ Low-tech, open-source innovation had a watershed year. Here are just a few of the simple, life-saving products that made a splash in 2013. If you want to appreciate the benefits of these DIY technologies, just pay a visit to rural Africa. —JONATHAN KEATS

Evocam Endoscope

This simple camera and light source allows diagnosis and treatment of vesicovaginal fistula, a complication of childbirth among more than 2 million women in the developing world and common in sub-Saharan Africa, that results in a potentially deadly opening between the bladder and vagina. A traditional endoscope — a flexible fiber-optic tube used to look inside the body — costs as much as \$70,000 and must be plugged in. San Francisco biomedical engineer Moshe Zilversmit's Evocam costs less than \$2,500 and runs off a battery-powered laptop.



THIS AFFORDABLE ENDOSCOPE can run off of a battery-powered laptop.



DOUBLE-SIDED TAPE and a glass lens turn a smartphone into a field microscope. The two images above show parasitic worm eggs under a traditional microscope (left) and with the iPhone version (right).

iPhone Microscope

A \$9 spherical glass lens taped to an iPhone camera provided Toronto General Hospital internist Isaac Bogoch with a field microscope to diagnose parasitic infections in Tanzania. A stool sample on a slide is illuminated with a dollar-store flashlight; the simple setup provides at least 50x magnification — enough to spot many parasites. Bogoch's 2013 Tanzania study is proof-of-concept that readily available smartphones can be deployed as medical instruments. And there's a bonus: Inexperienced clinicians unsure of a diagnosis can get a second opinion by tweeting the photo to colleagues.

RHU/Ikea Refugee Housing

In Ethiopia, 20 Somali refugee families have been living in these houses since August, prototypes of a lightweight, durable, insulating shelter developed by the Swedish design team Refugee Housing Unit and funded by the Ikea Foundation. Conventional refugee tents allow little privacy at night when lights from inside cast shadows, but these units use a novel polymer that lets in sunlight and blocks shadows. Two people can carry one shelter kit — conveniently boxed in Ikea-inspired flat packing. And with an expected life span of more than three years — six times longer than traditional refugee tents — these houses may out-survive the crisis, in which case they're designed to be disassembled and rebuilt on more permanent ground.

PORTABLE AND PRIVATE refugee housing from Swedish designers made its debut this year. Funded by Ikea, the housing is durable enough to last years and be carried to a more permanent residence.

