Unusual twist found in protein-DNA pairing

Cells keep the instructions for making proteins locked up in their genes. Each gene consists of DNA, which is made up of pairs of nucleotide bases strung together in a specific order. That order tells RNA what amino acids, the building blocks of proteins, to make – but the instructions are in code. RNA molecules can read that code only if the base pairs split into strings of single nucleotides.

The locksmiths responsible for splitting these pairs include a variety of specialized molecules, in particular one called the TATA-box binding protein (TBP). This protein gets its name from the nucleotide sequence it seeks out – TATA, T for thymine, A for adenine.

Until now, geneticists and biochemists could only guess how TBP readied DNA pairs for unlocking. But the surprising results of two research groups working independently show that TBP kinks and stabilizes DNA in a way that makes it more receptive to other molecular locksmiths. The two teams describe their crystallization work in the Oct. 7 NATURE.

"[The results] show dramatic changes in the conformation of [DNA's] double helix, the like[s] of which have never been seen before in any DNA-protein complex," comments Aaron Klug of the Medical Research Council Laboratory of Molecular Biology in Cambridge, England. The findings set the stage for elucidating the steps that initiate the reading of the DNA code.

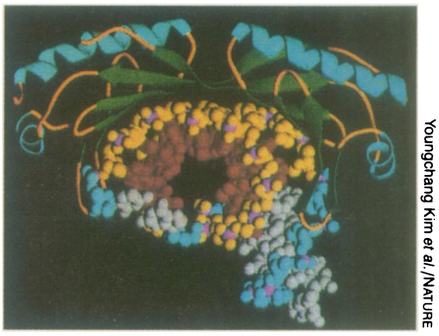
Shaped like a saddle, the TBP of the plant *Arabidopsis thaliana* causes the DNA that lies under it to arch sharply upward, conforming to the protein's concave shape, report structural biologist Joseph L. Kim and his colleagues at Rockefeller University in New York City.

Likewise, when saddle-shaped yeast TBP binds to DNA containing the TATA box, it causes that DNA to bend sharply in two places and the base pairs in between to lose their helical twist, says Paul B. Sigler, a structural biologist at Yale University.

"The structures agree very nicely," Kim says. Even though the two research teams used different DNA strands and types of TBP, both TBP molecules contain a 180-amino-acid section that links to the TATA box. No one knows what the rest of the TBP molecule does, he adds.

Scientists had thought DNA would orient along TBP much as a horse's backbone fits under a saddle, says Sigler. Instead, eight DNA base pairs lie across the protein saddle. Amino acids sticking out of the saddle like stirrups wedge between the first and second and the seventh and eighth base pairs, causing the DNA to bend sharply there, he explains. The middle base pairs snuggle up under the saddle, helping to stabilize this new DNA configuration, adds Kim.

"You're not used to looking at such highly distorted DNA," says Kim. "It was a very unusual result, so it was probably beneficial that there were two independent results." – *E. Pennisi*



Youngchang Kim et al./NATURE

Computer graphic of DNA (balls) bound to the underside of TBP (ribbon).

Antarctic ozone level reaches new low

Thanks in part to Mt. Pinatubo's lingering legacy, the seasonal ozone hole over Antarctica set a new record last week. Measurements made by satellite and by balloon-borne and ground-based instruments indicate that ozone concentrations above the frozen continent plummeted to an all-time low.

Instruments flown on balloons from the U.S. research station at the South Pole reveal that from late August to early October, about 70 percent of the ozone disappeared from Antarctic skies, says David J. Hofmann of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colo. On Oct. 6, the balloon ozone sensors detected only 90 Dobson units of ozone, a reading corroborated by a ground-based spectrometer.

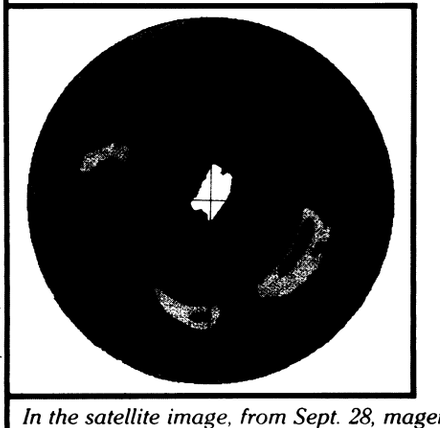
"This is the lowest value of total ozone ever recorded on Earth," Hofmann told SCIENCE NEWS. The previous record low, set last year, was 105 Dobson units.

The Antarctic ozone hole forms during the southern hemisphere's springtime, when sunlight returns to the dark polar sky, energizing chlorine and bromine pollutants that break apart ozone molecules in the stratosphere. Such chemical destruction weakens the protective layer that normally absorbs ultraviolet radiation from the sun. The region of ozone-poor air breaks up in late October and November.

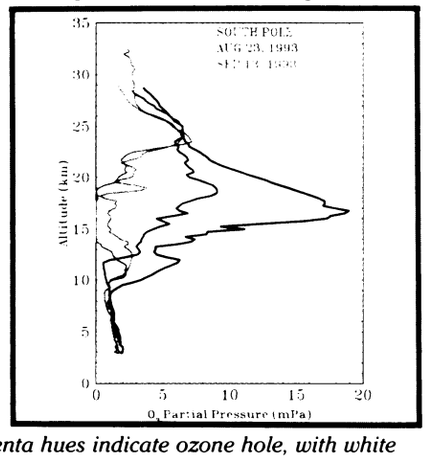
Measurements made by a U.S. ozone spectrometer flying on a Russian satellite show that the hole grew to cover an extraordinarily large area for the second year in a row. The region of ozone-depleted air spread over 23 million square kilometers, almost the size of the entire North American continent. The hole measured 15 percent larger than it has in most previous years, says Arlin J. Krueger of NASA's Goddard Space Flight Center in Greenbelt., Md.

Scientists remain unsure why the hole has grown so large in the last two years, but they suspect a link with the eruption of Mt. Pinatubo, which flooded the stratosphere with tiny droplets of sulfuric acid. These aerosols can provide a surface for chemical reactions involved in the destruction of ozone.

Balloon measurements from the South Pole support the Pinatubo theory. In the last two years, ozone loss has occurred lower in the stratosphere than in years past (SN: 10/24/92, p.278). Because this is the same region where Pinatubo aerosols reside, Hofmann suggests they have enhanced the hole's development by enabling chlorine to attack ozone over a greater vertical range. – *R. Monastersky*



NASA/NOAA, CMDL



In the satellite image, from Sept. 28, magenta hues indicate ozone hole, with white marking the most depleted region. Graph shows vertical profiles of ozone over South Pole. Black line represents conditions prior to hole's development. Green, blue, and red lines show how ozone disappeared over a six-week period.