In This Issue

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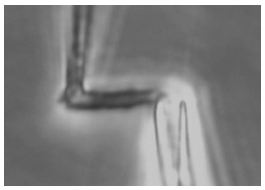
Tangled DNA tightens chromosomes



A chromosome under tension (horizontal, hair-like object) stretches farther after addition of topoisomerase II.

Cramming your vacation wardrobe into your luggage is a breeze compared with the packing job cells perform. Before they can divide, they have to scrunch long DNA molecules into tiny chromosomes. The tangles that form in DNA molecules help this chromosome compression, Kawamura et al. report.

The team studies newt chromosomes—they are large and convenient to observe—that are packing masters. Jammed into a 10-micron–long chromosome is a meter-long DNA molecule. Proteins such as condensins bunch up the DNA. They aren't the whole story, however, since protein-degrading enzymes don't spur chromosomes to completely unravel. The DNA itself is tangled, and these knots might also help the chromosome stay taut, Kawamura et al. hypothesized.

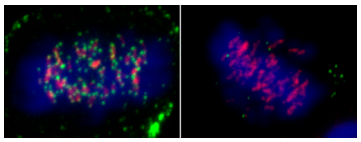
To test the idea, the researchers sprayed isolated newt chromosomes with topoisomerase (topo) II. This enzyme untangles DNA knots by severing the double helix, slipping the uncut strand through the opening, and then sealing the break.

By pinning down one end of the chromosome and pulling on the other end, the team gauged topo II's effect on chromosome stretchiness. Topo II relaxed the chromosome by about 35%, as measured by the amount of force required to lengthen it a certain amount. However, topo II's cousins topo I and topo III, which can also loosen DNA, had little effect.

The results suggest that DNA knots collaborate with proteins to compact chromosomes. Topo II, which can tighten chromosomes in certain situations, might have a dual role in cells, compressing DNA early in mitosis and loosening it after the chromosomes have separated.

Kawamura, R., et al. 2010. *J. Cell Biol.* doi:10.1083/jcb.200910085.

SENP6 cuts SUMOs down to size



The kinetochore protein CenpH (green in left panel) vanishes when SENP6 is absent (right).

Kinetochore formation involves some SUMO wrestling. Two opposing proteins involved in the SUMO pathway control assembly of the structures, Mukhopadhyay et al. reveal.

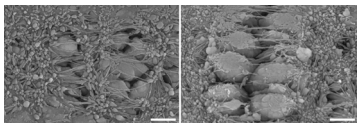
Addition of a SUMO molecule can alter a protein's location, stability, and other characteristics. But SUMOylation can also lead to the protein's demise. The enzyme RNF4 targets proteins carrying SUMO chains of a certain length, tagging them with ubiquitin to spur their destruction. Another enzyme, SENP6, spares proteins by shortening SUMO chains. Mukhopadhyay et al. investigated how the balance between SENP6 and RNF4 affects kinetochore assembly.

Mitosis stalled in cells lacking SENP6, and chromosomes often didn't line up properly during metaphase. Those defects also appear in cells that are missing the CENP-H/I/K complex, which helps insert other molecules into the forming kinetochore. When SENP6 was absent, CENP-H and CENP-I vanished from the inner part of the kinetochores. So did other proteins that the CENP-H/I/K complex helps put in place, such as CENP-O.

Further experiments suggested that the missing CENP-I had been destroyed. Removing RNF4 or disabling the proteasome, which demolishes ubiquitin-tagged molecules, caused CENP-I levels to return to normal. The overall picture is that SENP6 permits kinetochore assembly by preventing RNF4 from ubiquitinating CENP-I. Why cells adopt this indirect mechanism to control ubiquitination isn't clear. CENP-I might require SUMOylation to do its job, the researchers speculate.

Mukhopadhyay, D., et al. 2010. *J. Cell Biol.* doi:10.1083/jcb.200909008.

Neighbors limit cell renovations



Reducing the number of adherens junctions causes epithelial tissue to rip (right), though the cells remain linked by strands of membrane.

No cell is an island, especially when it's embedded in an epithelial layer of a fruit fly embryo. As Martin et al. reveal, forces transmitted among surrounding cells restrict how the cell can change shape during development.

The bending, twisting, and folding of embryonic development often entails changes in cell shape. A column-shaped cell can compress its upper section, becoming a wedge or cone—a process called apical constriction. When neighboring cells perform this maneuver in concert, epithelial tissue folds or buckles. Apical constriction helps relocate future mesoderm cells during gastrulation in *Drosophila*, for example. However, apical constriction occurs predominantly in the ventral–lateral (side-to-side) direction, not the anterior–posterior (front-to-back) direction. It's possible that the cell contracts in just one dimension or that the surrounding tissue exerts a force that limits the cell to constricting ventro-laterally.

Martin et al. found evidence for the second alternative when they observed *Drosophila* mesoderm tissue that normally folds to form a structure called the ventral furrow. Extending throughout the tissue is a mesh of actin and myosin that travels from one cell to another via adherens junctions. The researchers weakened intercellular connections by reducing the number of these junctions. Cells pulled apart, and the tissue often tore along the anterior–posterior axis. After such tears, which appear to release epithelial tension, cells began to constrict in both directions, not just side-to-side. The results suggest that tension in the tissue, which spreads through the actin-myosin network, normally prevents apical constriction from occurring in both directions.

Martin, A.C., et al. 2010. *J. Cell Biol.* doi:10.1083/jcb.200910099.