Embryonic stem cells do better on bumpy nanoscale mattress

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Nothing in the cellular world is flat. Even the flattest of basement membranes has topography; bumps, if you like, beneath the cellular mattress.

Unlike the princess kept awake by the pea, human embryonic stem (HES) cells do better when cultured on a substrate deliberately printed with nanoscale grooves and ridges, according to researchers from the University of Wisconsin–Madison.

The researchers used soft lithography to stamp polyurethane substrates with a nano- micron scale topography; a rugged cellular landscape ranging from a few billionths to a few millionths of a meter in altitude.

The HES cells in culture seemed to appreciate the bumps. A line of HES cells grown for five days on the artificial ridges and grooves kept their "stemness," their self-renewing phenotype, far better than HES cells plated on standard flat culture surfaces, according to Daniel McFarlin, K.J. Finn, and Chris Murphy of the University of Wisconsin's School of Veterinary Medicine, who teamed with P.F. Nealey of the University's Department of Chemical Engineering.

Unlike stem cells derived from adult tissues, which have a limited number of cell doublings, embryonic stem cells cultured under the right conditions have the potential to divide indefinitely, without losing their pluripotent properties. But until now, HES cell cultures had a tendency to spontaneously differentiate, that is, to veer off without warning into a

developmental pathway. HES cell cultures have to be closely watched to remove any of these spontaneously differentiated colonies.

Researchers have looked at surface chemistry, growth factors, and mechanical forces as factors in runaway stem cell differentiation, but topography is a new dimension for HES, say Murphy and McFarlin, and a highly promising one.

This is the first demonstration that the physical topography, using controlled feature dimensions, of cell culture surfaces influences HES cell differentiation and self-renewal, according to the researchers. For HES cells to realize their potential in clinical medicine, they would have to be cultured in great quantities and with great fidelity to their pluripotent phenotype. Fine-tuning their nano-micro topography could boost the efficiency of HES cell propagation.

Source: American Society for Cell Biology