

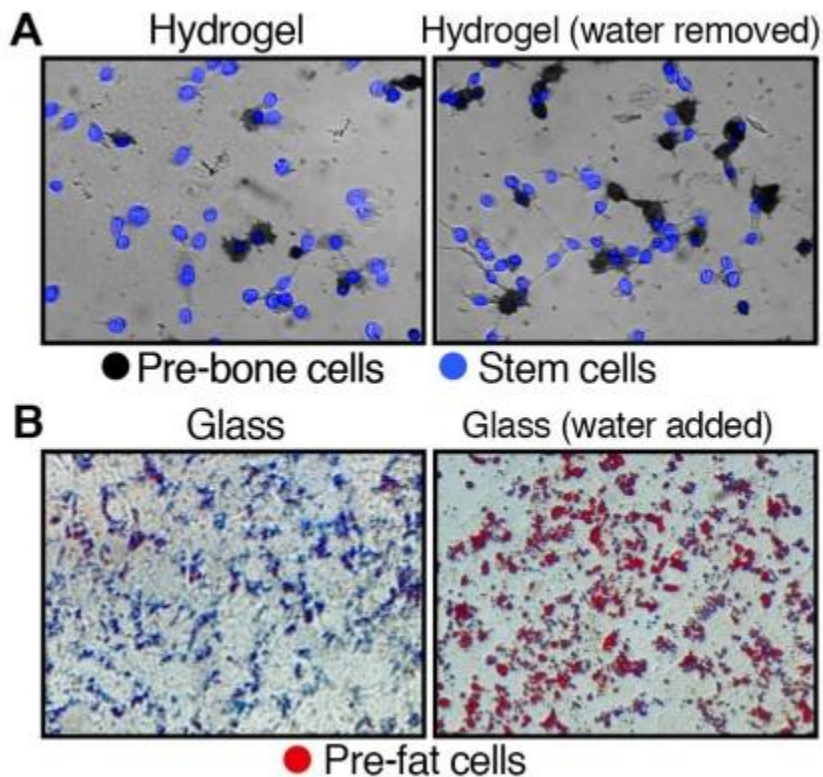
Amount of water in stem cells can determine its fate as fat or bone

Study is first to find cell volume can influence the future role of stem cells, regardless of environment.

September 26, 2017

Adding or removing water from a stem cell can change the destiny of the cell, researchers have discovered in a new study published in the Proceedings of the National Academy of Sciences (PNAS).

The research found that altering the volume of a cell changed its internal dynamics, including the rigidity of the matrix lining the outer surface. In stem cells, removing water condenses the cell, influencing the stem cells to become stiff pre-bone cells, while adding water causes the cells to swell, forming soft pre-fat cells.



Researchers have long understood that stem cells are influenced by the cells around them, picking up cues on what their function should be based on the stiffness of the matrices of neighboring cells.

The results, however, confirm that nature plays as much of a role as nurture in stem cell behavior and development.

The line between bone and fat

These changes in volume are a result of variations in the amount of protein, DNA and other materials within the cell, though they mostly remain constant. But cells can also experience rapid and extreme changes in size and density through the absorption or release of water, spreading or shrinking in as little as 20 minutes.

By increasing or decreasing the volume of cells by 20 percent, the investigators found that the cells experienced several internal changes, including in gene expression and stiffness.

Knowing the role cell stiffness plays in the development of stem cells, the researchers began to wonder if cell volume could affect their fate as well.

To test the premise, investigators placed stem cells at their normal volume in a hardened hydrogel substrate to simulate the rigidity of bone cells. After one week, a large portion of the stem cells developed into pre-bone cells.

The experiment was repeated with a softened hydrogel substrate. In the softer environment, there was a significant decrease in the number of stem cells that became pre-bone cells. However, when water was removed from the cells to decrease their volume by 20 percent, the number of stem cells that became pre-bone cells increased, despite being in the softer substrate.