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Understanding Chromosome Movement in Starfish Oocytes

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Abstract : Many cell and tissue culture practices ignore the effects of gravity on cell biology, and little is known about how cell components may move in response to gravitational forces. Starfish oocytes provide an excellent model for interrogating the movement of cell components due to their unusually large size, ease of handling, and high transparency. Chromosomes from starfish oocytes can be visualised by microinjection of the histone-H2B-mCherry plasmid into the oocytes. The movement of the chromosomes can then be tracked by live-cell fluorescence microscopy. The results from experiments using these methods suggest that there is a replicable downward movement of centrally located chromosomes at a median velocity of 0.39 µm/min. Chromosomes nearer the nuclear boundary showed more restricted movement. Chromosome density and shape could also be altered by microinjection of restriction enzymes, primarily Alu1, before imaging. This was found to alter the speed of chromosome movement, with chromosomes from Alu1-injected nuclei showing a median downward velocity of 0.60 µm/min. Overall, these results suggest that there is a non-negligible movement of chromosomes in response to gravitational forces and that this movement can be altered by enzyme activity. Future directions based on these results could interrogate if this observed downward movement extends to other cell components and to other cell types. Additionally, it may be important to understand whether gravitational orientation and vertical positioning of cell components alter cell behaviour. The findings here may have implications for current cell culture practices, which do not replicate cell orientations or external forces experienced in vivo. It is possible that a failure to account for gravitational forces in 2D cell culture alters experimental results and the accuracy of conclusions drawn from them. Understanding possible behavioural changes in cells due to the effects of gravity would therefore be beneficial.

Keywords : starfish, oocytes, live-cell imaging, microinjection, chromosome dynamics
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