Come on in: Nuclear barrier less restrictive than expected in new cells

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When it comes to the two basic types of cells, prokaryotes and eukaryotes, compartmentalization is everything. Prokaryotes are evolutionarily ancient cells that only have a membrane surrounding their outer boundary, while the more complex eukaryotes have an outer membrane and membrane bound compartments within the cell. Perhaps most notable is the double layered membrane that surrounds the nucleus, the cellular compartment which houses the cell's genetic material.

The genetic material is very precious to the cell and is cautiously guarded by the nuclear membrane, known as the nuclear envelope (NE). The NE regulates movement of select molecules into and out of the nucleus via channels called the nuclear pore complex (NPC). Previous work has suggested that to cross the NE barrier, proteins must have a specific transport signal that can be recognized by the NPC or, to move by simple passive diffusion, must be very small. Now, two studies published by Cell Press in Biophysical Journal suggest that there are times when the NE is much more open to passive diffusion than originally believed.

While a eukaryotic cell divides into two new and identical cells (via a process called mitosis) the NE must be rapidly disassembled and then reformed. Although it has been generally accepted that the NE and NPCs have full functionality at the completion of mitosis, the specific timing of NE permeability barrier reestablishment has not been clearly established. Two independent research groups examined the timing of NE permeability in newly formed cells by using special inert proteins

that could be switched between a fluorescent and non-fluorescent state and followed from the cytoplasm into the nucleus. The proteins lacked a nuclear transport signal and had to enter the nucleus by passive diffusion.

In a study published on September 2nd, researchers from The Institute of Physical and Chemical Research in Saitama, Japan discovered a short period during which the NE barrier is far more permeable than previously thought. "We identified a short time just after mitosis during which large proteins can enter the nucleus by passive diffusion. The newly assembled nucleus seems to have let its guard down during this brief window," offers senior study author Dr. Atsushi Miyawaki. "Our study highlights the dynamic nature of the development of the NE and NPC."

A second study, published on October 6th, directly followed changes in NE permeability by using reversibly switchable fluorescent proteins to measure movement into the nucleus repeatedly in the same cells. The researchers, from the European Molecular Biology Laboratory in Heidelberg, Germany also observed that the permeability of the NE for passive diffusion is strongly increased early after mitosis and declines only gradually over a few hours. "It will be very interesting to determine the molecular mechanism and potential biological function underlying this initial openness of the nucleus for diffusion in future work," says senior study author Dr. Jan Ellenberg.

Source: Cell Press (news : web)