# 中国团队揭示哺乳动物着床前胚胎染色体三维结构重编程过程

# Chinese Scientists Have Successfully Established Allelic reprogramming of 3D chromatin architecture during early mammalian development

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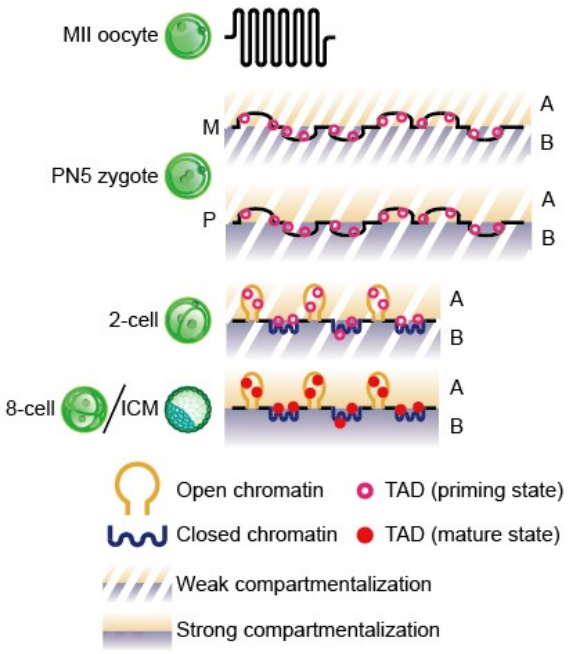
【Nature 系列】7 月 13 日，清华大学生命科学学院颉伟研究组在《Nature》期刊发表了题为“Allelic reprogramming of 3D chromatin architecture during early mammalian development”，系统揭示了哺乳动物染色体三维结构在着床前胚胎发育过程中的动态重编程过程。

在真核生物中，线性 DNA 通过多层级地折叠以特定的三维结构存在于细胞核中。染色质的三维结构对于基因表达调控、DNA 复制和重组等过程都具有至关重要的作用。近些年来，借助 Hi-C（whole genome chromosome conformation capture）等染色质三维结构研究技术，科研人员获得了不同物种多种类型细胞的全基因组染色体三维结构信息。

然而，由于细胞数量和实验手段的限制，染色体三维结构在哺乳动物早期胚胎发育过程中的动态变化却鲜为人知。清华大学颉伟研究组通过优化 Hi-C 技术，开发出了一套适用于极少量细胞的 Hi-C 技术（sisHi-C, small scale in situ Hi-C），并成功将其应用于小鼠早期胚胎发育过程中染色体三维结构的研究中，揭示了哺乳动物受精前后染色体三维结构的亲本特异重编程过程。他们发现，染色体的三维结构在受精后首先呈现出一种极其松散的状态，并在随后的胚胎早期发育过程中逐步地以亲本特异的方式建立和成熟。




染色体三维结构在小鼠早期胚胎发育过程中的重编程模型


**Allelic reprogramming of 3D chromatin architecture during early mammalian development**

**哺乳动物早期胚胎发育过程中染色体三维结构的亲本特异重编程**

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In mammals, chromatin organization undergoes drastic reprogramming after fertilization1. However, the three-dimensional structure of chromatin and its reprogramming in preimplantation development remain poorly understood. Here, by developing a low-input Hi-C (genome-wide chromosome conformation capture) approach, we examined the reprogramming of chromatin organization during early development in mice. We found that oocytes in metaphase II show homogeneous chromatin folding that lacks detectable topologically associating domains (TADs) and chromatin compartments. Strikingly, chromatin shows greatly diminished higher-order structure after fertilization. Unexpectedly, the subsequent establishment of chromatin organization is a prolonged process that extends through preimplantation development, as characterized by slow consolidation of TADs and segregation of chromatin compartments. The two sets of parental chromosomes are spatially separated from each other and display distinct compartmentalization in zygotes. Such allele separation and allelic compartmentalization can be found as late as the 8-cell stage. Finally, we show that chromatin compaction in preimplantation embryos can partially proceed in the absence of zygotic transcription and is a multi-level hierarchical process. Taken together, our data suggest that chromatin may exist in a markedly relaxed state after fertilization,

followed by progressive maturation of higher-order chromatin architecture during early development.