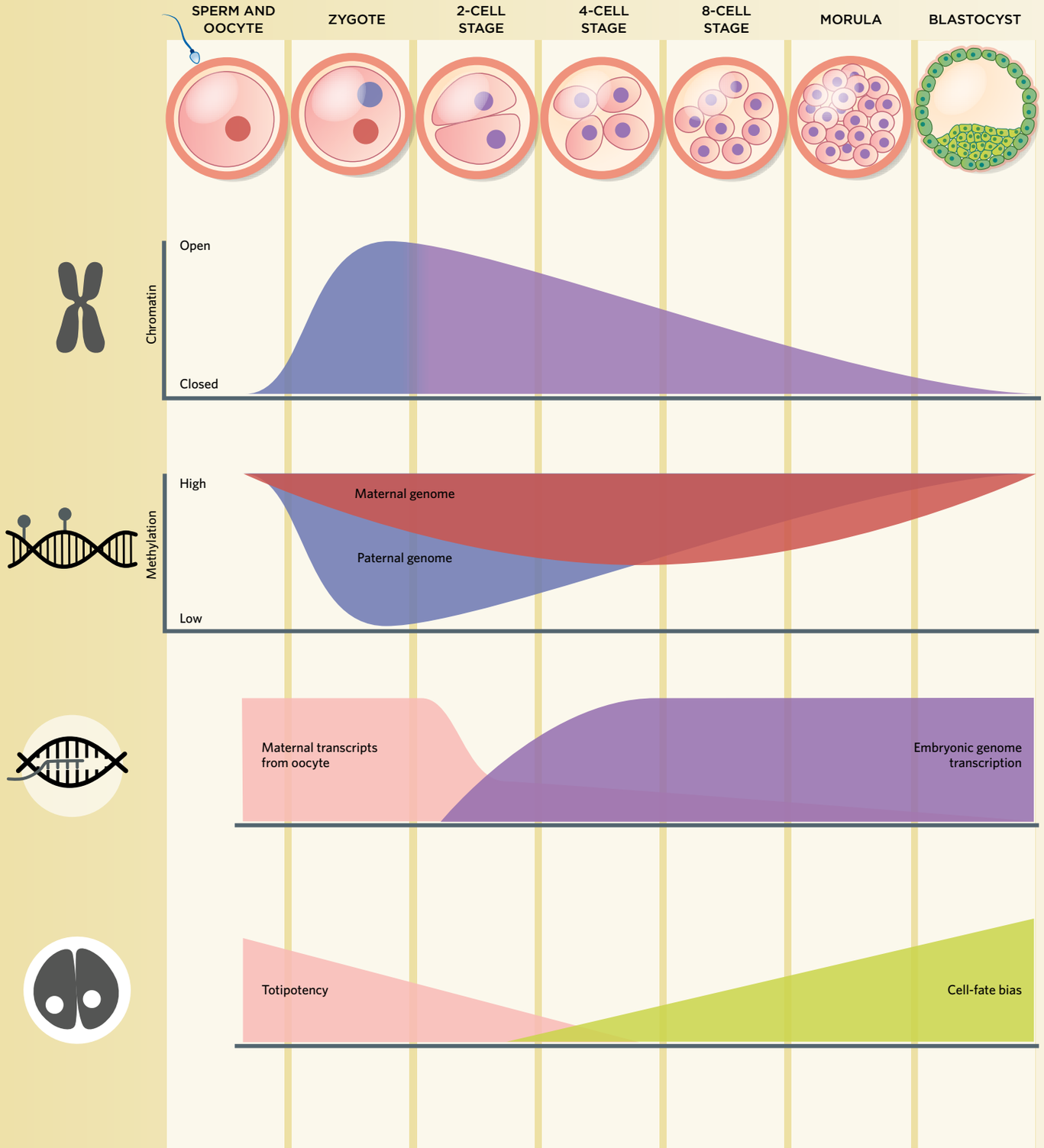
TAKING CONTROL

In the first hours after fertilization, maternal factors residing in the oocyte cytoplasm dictate early development. But soon, the zygote's genes start to take over. This maternal-to-zygotic transition involves massive epigenetic reprogramming, from the overall structure of the chromatin to the complete resetting of methylation on the genome. (Note: Most of the information depicted below is based on studies of mouse embryos; there are some differences in the timing of these events in human embryos.)



CHROMATIN CHANGES

In sperm, chromatin is very compact; the overall accessibility of the chromatin in the oocyte, which is still undergoing meiosis, is unclear. Shortly after fertilization, chromatin in both pronuclei undergoes major restructuring, taking on an open configuration before reestablishing local and global organizational features.

METHYLATION CHANGES

Following fertilization, the vast majority of methyl marks on the genome are removed. The paternal genome undergoes rapid, active demethylation, while the maternal genome loses its methylation passively over the first couple of cell divisions. Simultaneously, the embryonic genome begins to acquire tissue-specific DNA methyl marks as the cells start to differentiate.

TRANSCRIPTION CHANGES

Messenger RNAs packaged in the oocyte are gradually depleted over the first week of development. Meanwhile, the zygotic genome undergoes multiple rounds of activation, with the genes expressed early on playing key roles in embryonic organization and cell-fate determination.

CELL-FATE DETERMINATION

By the four-cell stage, some cells begin to express genes that drive them to become the embryonic lineage that will form the fetus, while other cells begin to express genes associated with the extraembryonic lineage that becomes the placenta.