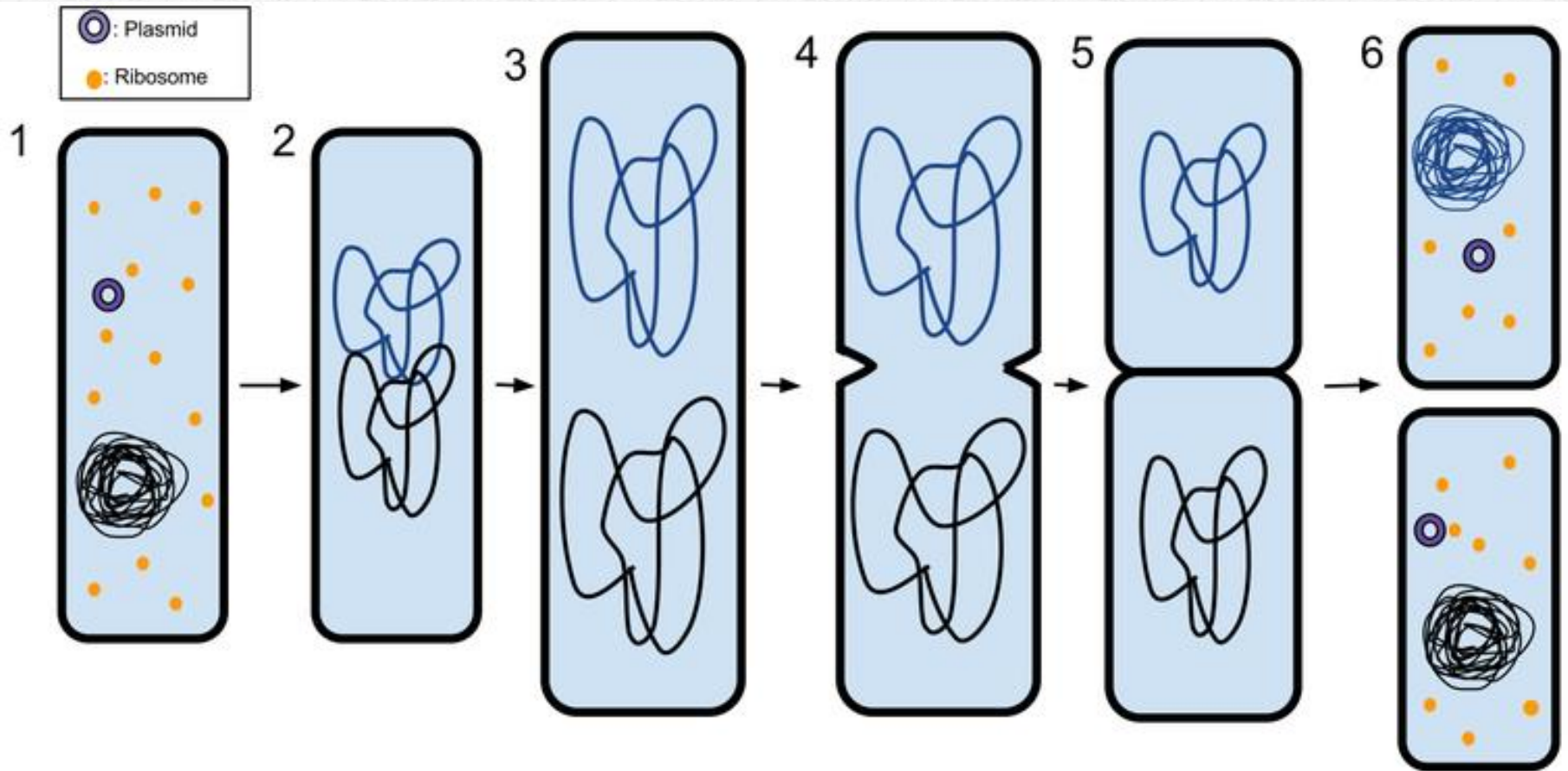


4.2: In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.

1. Mitosis

All cells reproduce by division

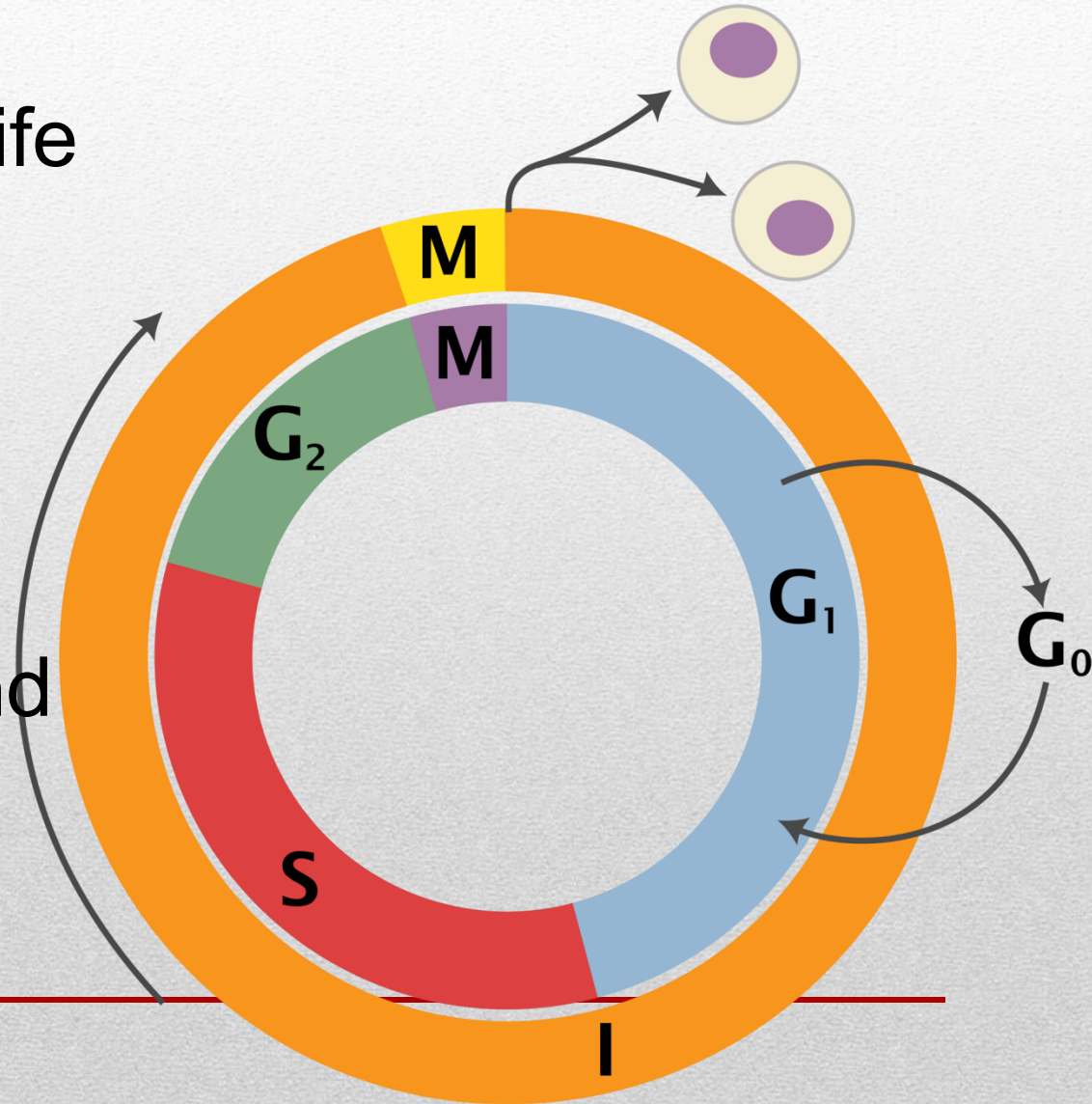
“Binary Fission” in Prokaryotes



The cell cycle

Major stages of a eukaryotic cell's life cycle.

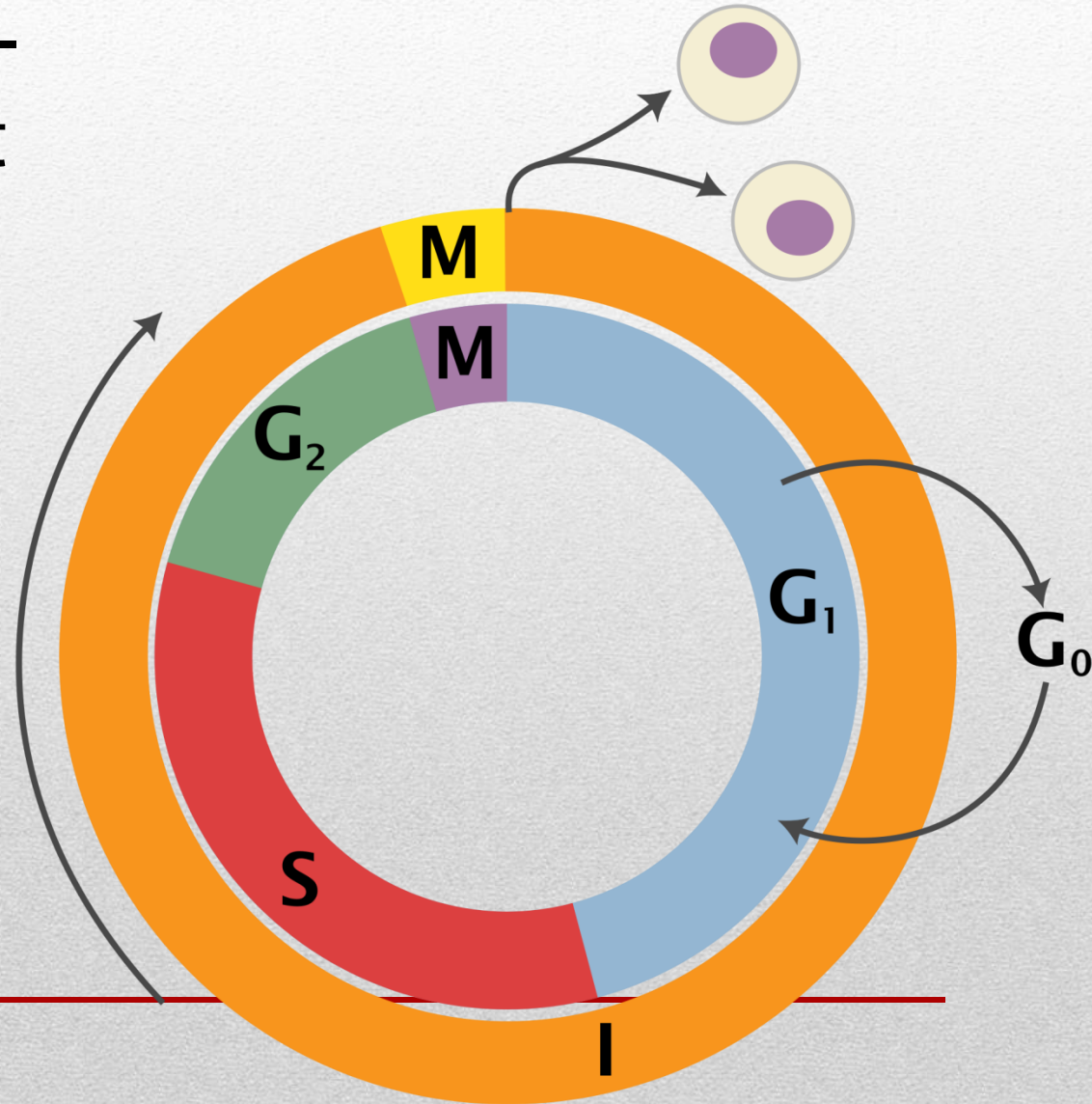
How eukaryotic cells accomplish the processes of growth, repair, and reproduction.



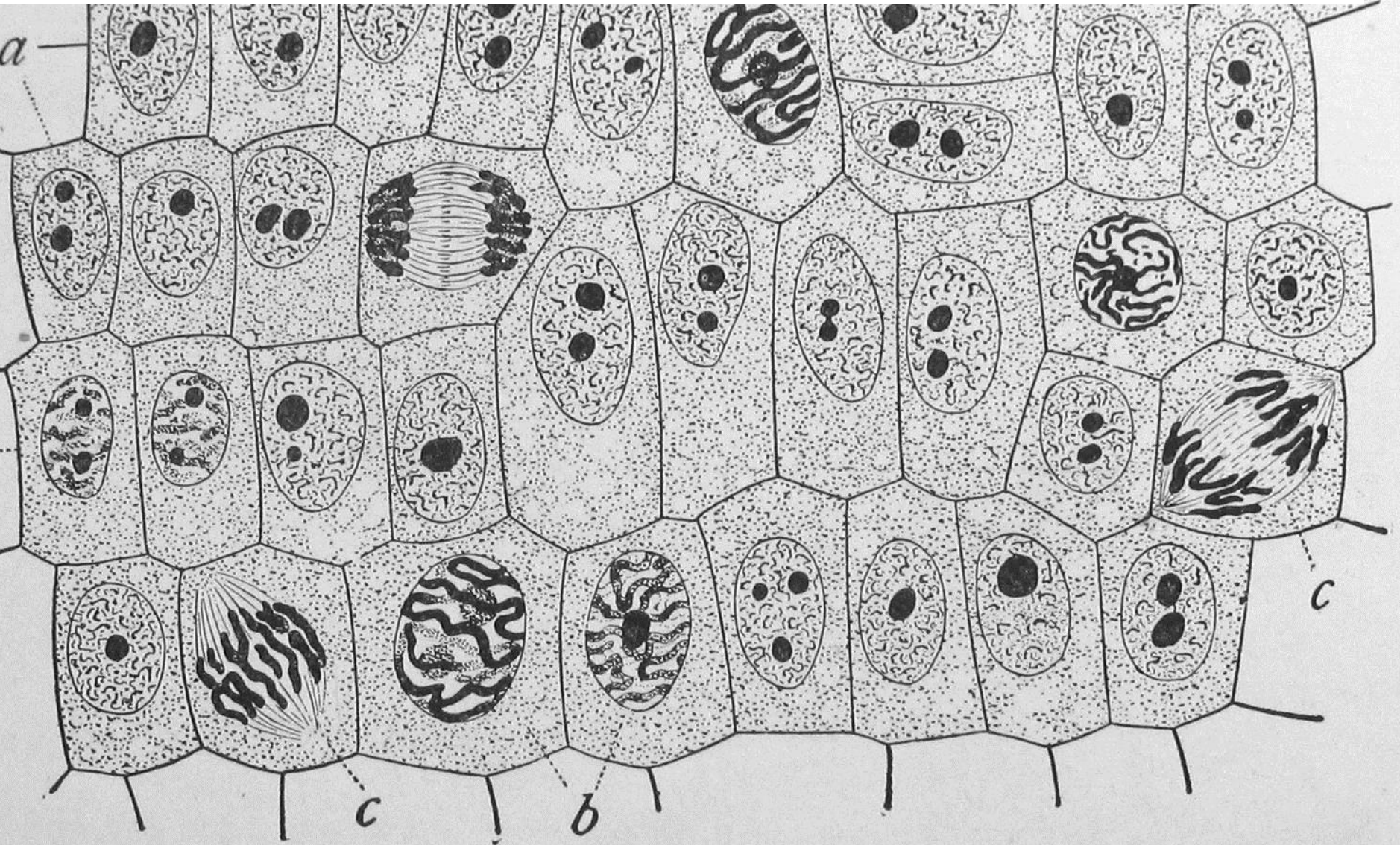
The cell cycle

Interphase: non-dividing life (most of the cell cycle).
 $G_1 \rightarrow S \rightarrow G_2$

M-phase: cell division.



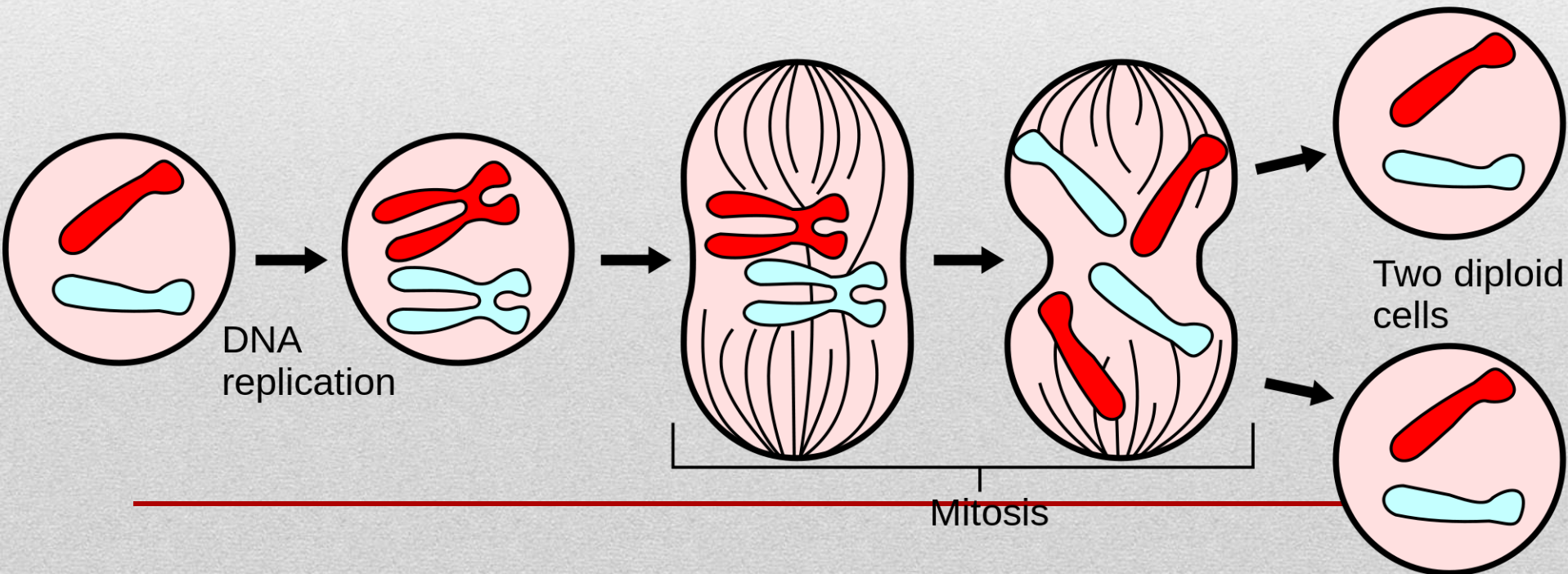
The behavior of chromosomes during the cell cycle allows for heritability



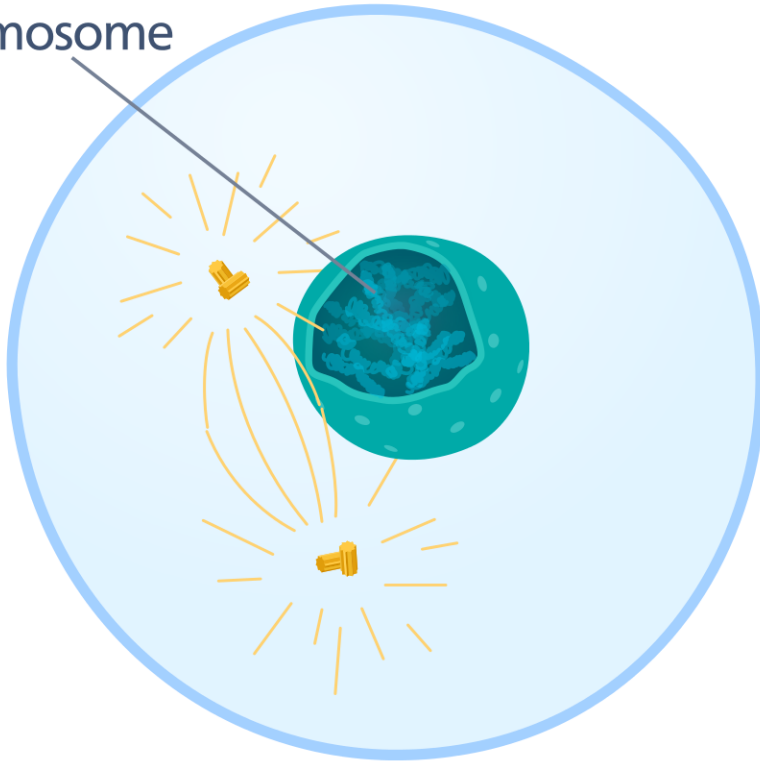
Mitosis

Produces two genetically identical “daughter” cells.

Chromosomes duplicated in S phase condense, align, and separate.



Chromosome



Prophase

Chromatin condenses
into chromosomes

Nucleolus disappears

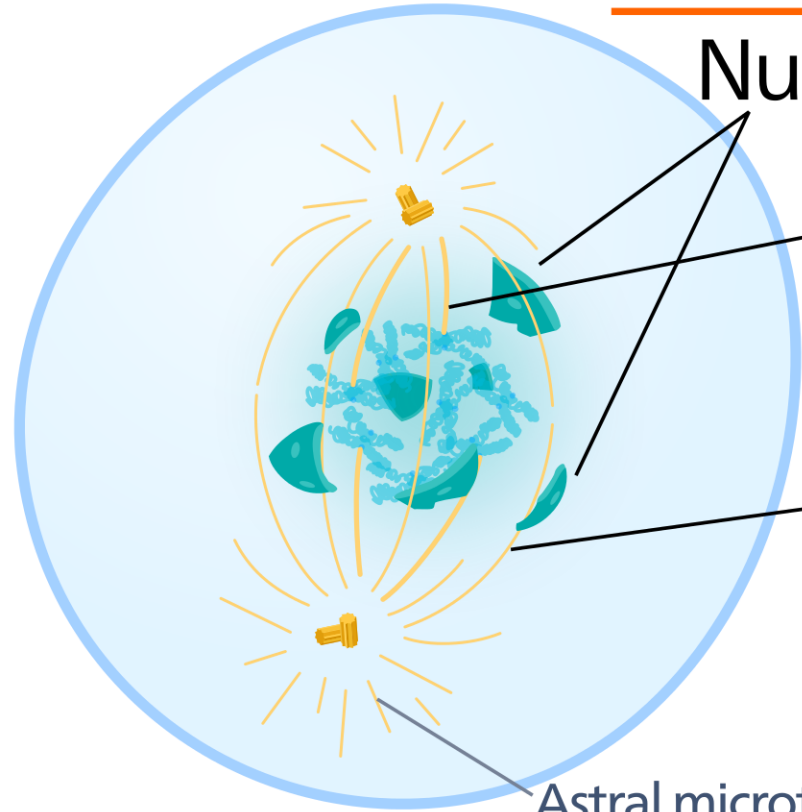
Prometaphase

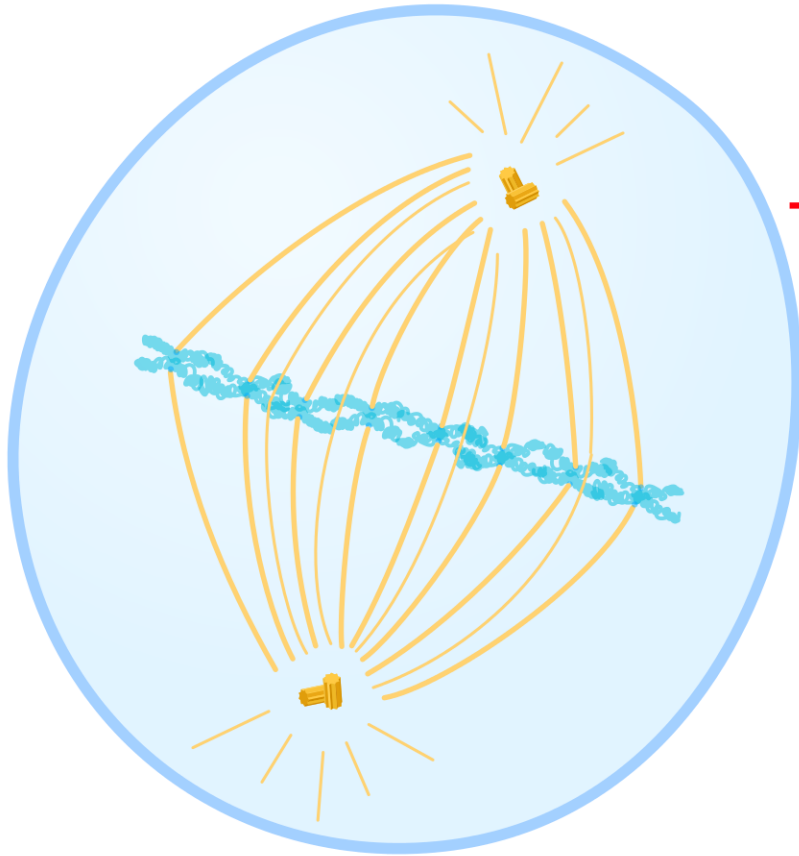
Nuclear membrane breaks down

Kinetochores microtubules invade nuclear space, and attach to **kinetochores**

Polar microtubules push against each other, moving centrosomes apart

Astral microtubules



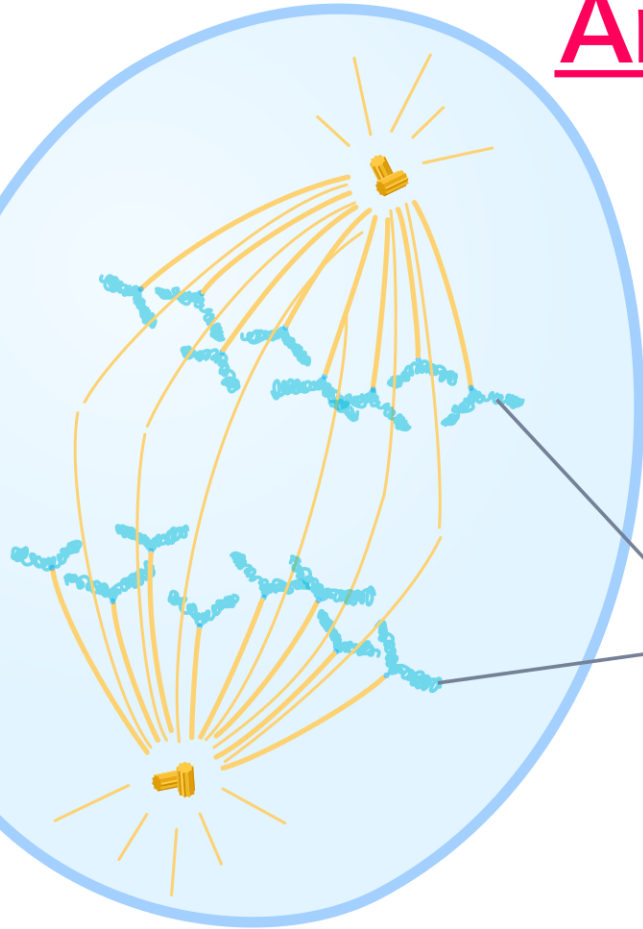


Metaphase

Chromosomes line up
along metaphase plate
(imaginary plane)

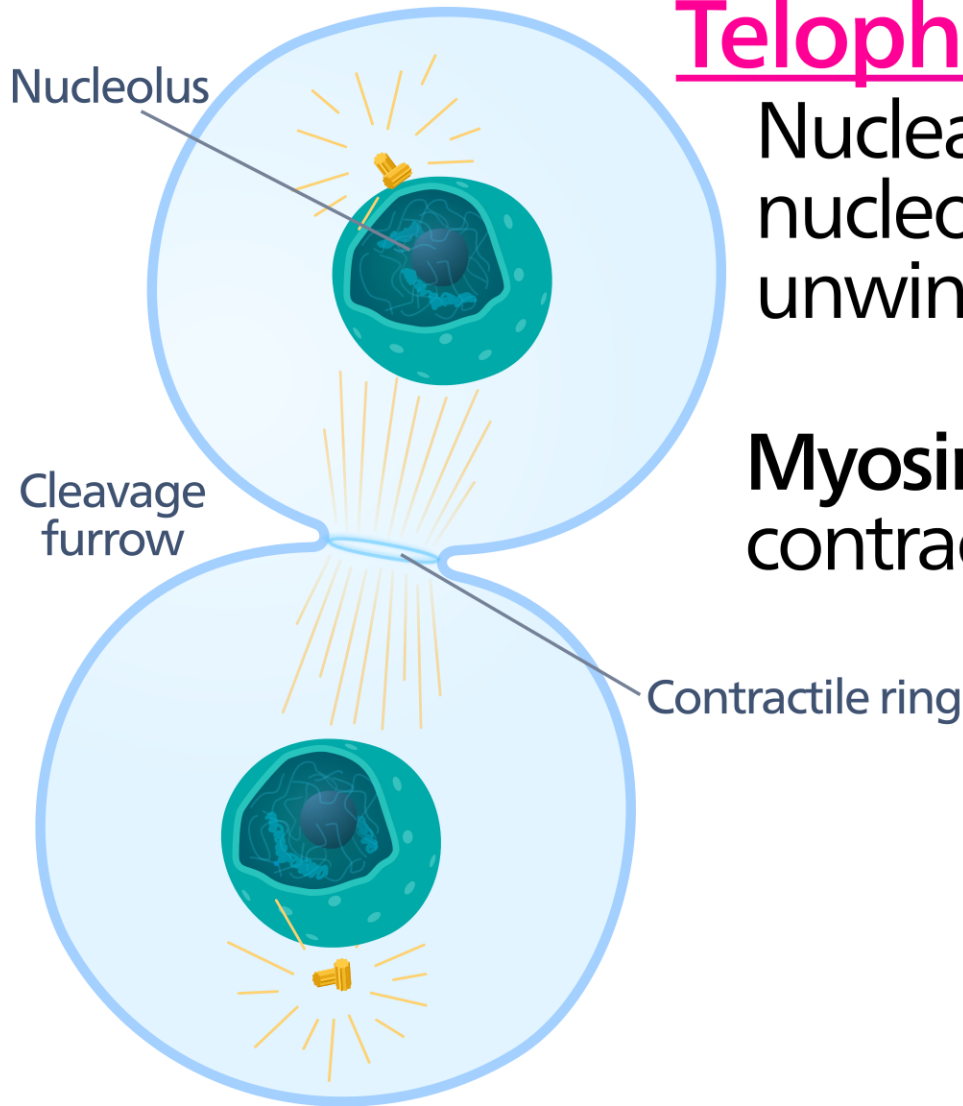
Anaphase

Chromosomes break at **centromeres**, and **sister chromatids** move to opposite ends of the cell



Sister chromatids

Telophase and Cytokinesis




Nuclear membrane reforms, nucleoli reappear, chromosomes unwind into chromatin

Myosin II and **actin** filament ring contract to cleave cell in two



Video Animation

http://www.youtube.com/watch?v=cvlpmmvB_m4



4.2: In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.

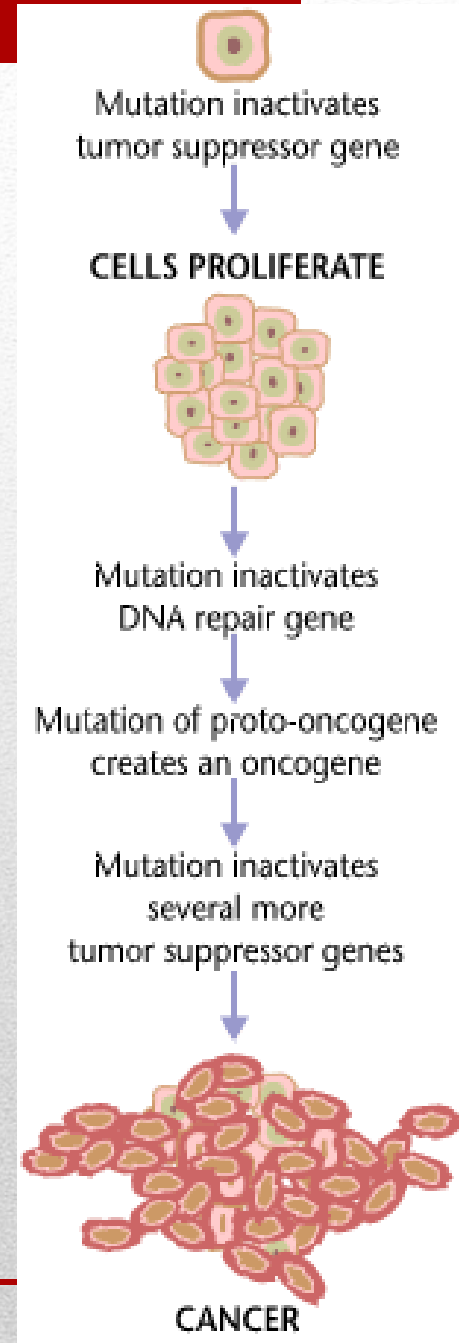
2. Cell Cycle Control

Control of Cell Division

Mitosis is under strict cellular control. Cells must pass through a series of “checkpoints” to be allowed to divide.

If internal conditions are not appropriate, cell division will normally be prevented.

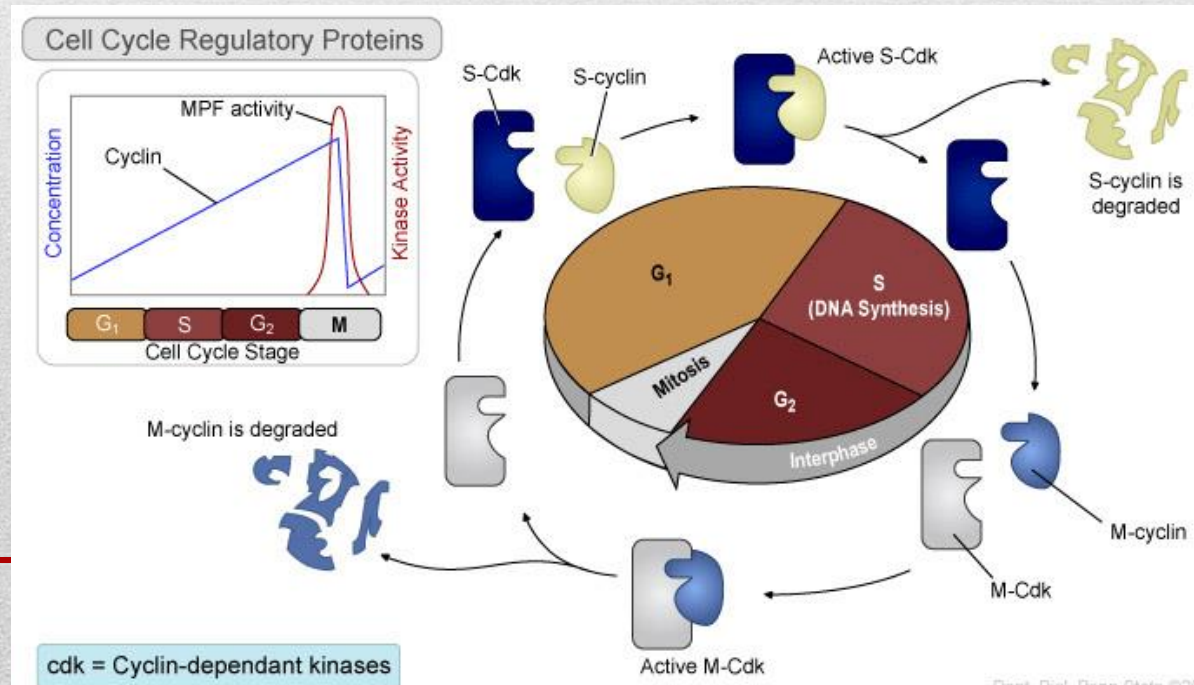
Cancer: Uncontrolled cell division.



Internal control of division

Cells control cell division by controlling the presence or absence of proteins that allow for cell division.

Ex. Mitosis Promotion Factor



External Control of Division

Progression through the cell cycle can be triggered by external signals.

Ex. Platelet Derived Growth Factor



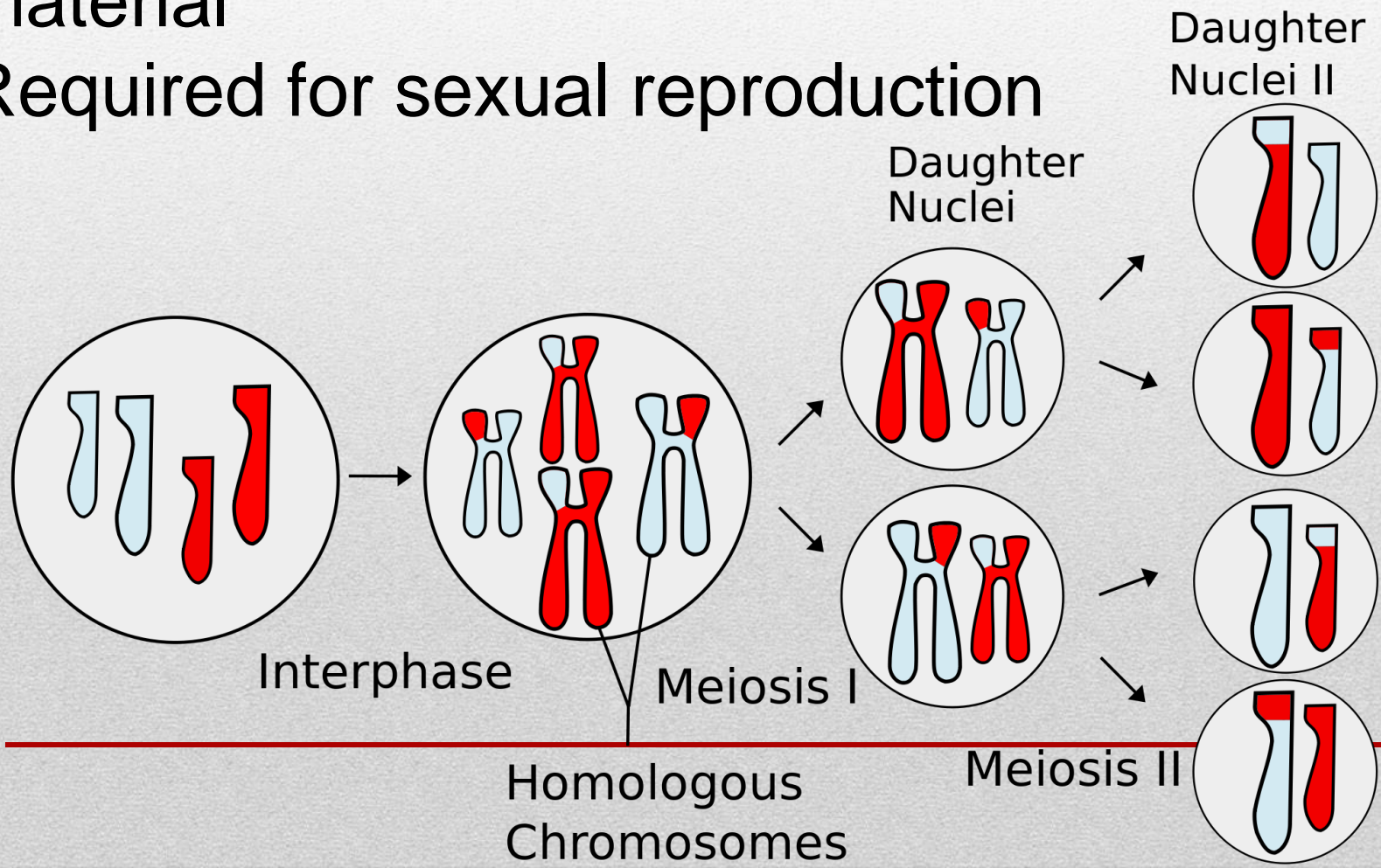
4.2: In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.

3. Meiosis

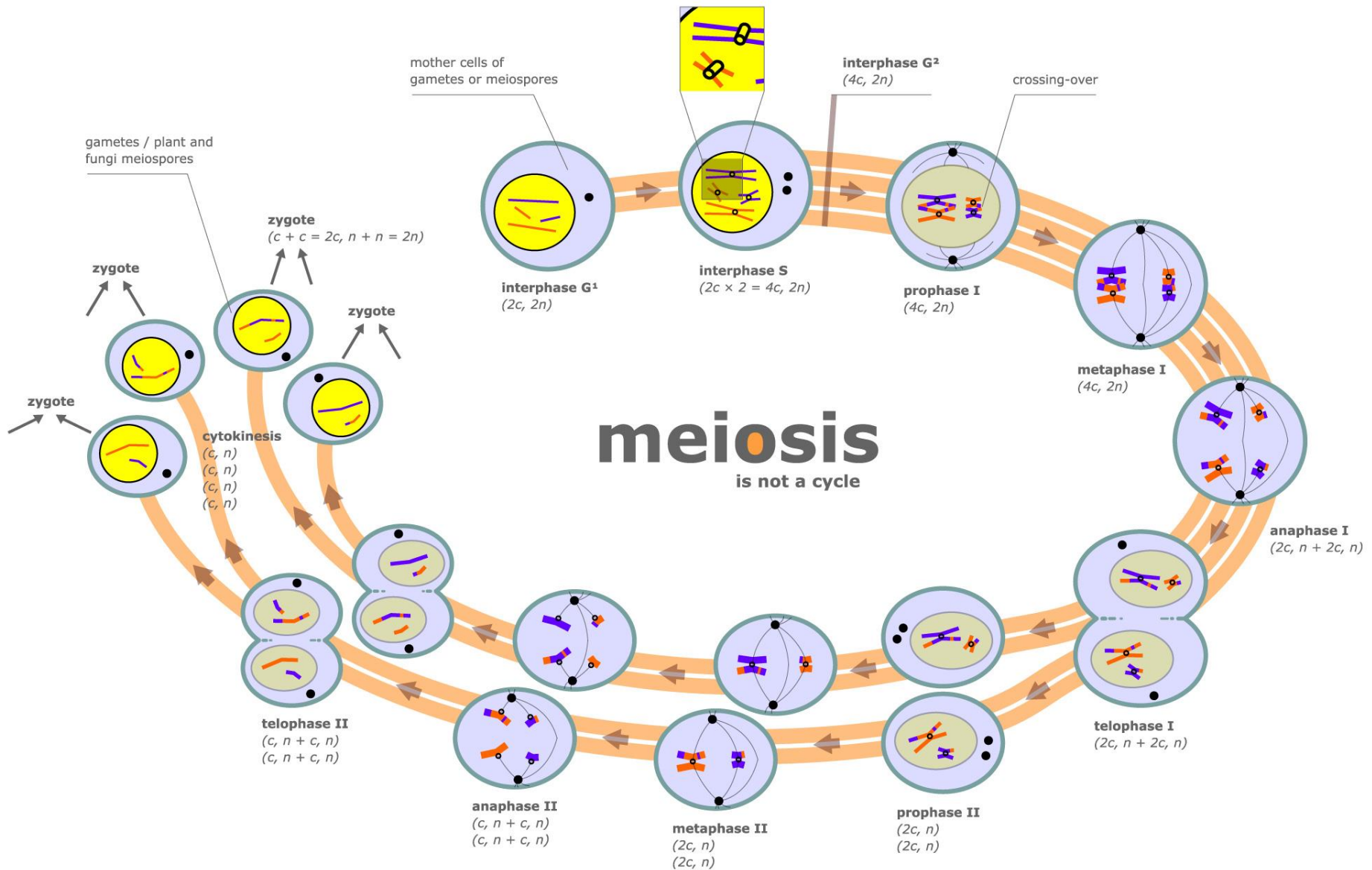
Meiosis

Produces four genetically unique gametes with half of the normal amount of genetic material

Required for sexual reproduction



Meiosis has 2 rounds of cell division with no S-phase between them

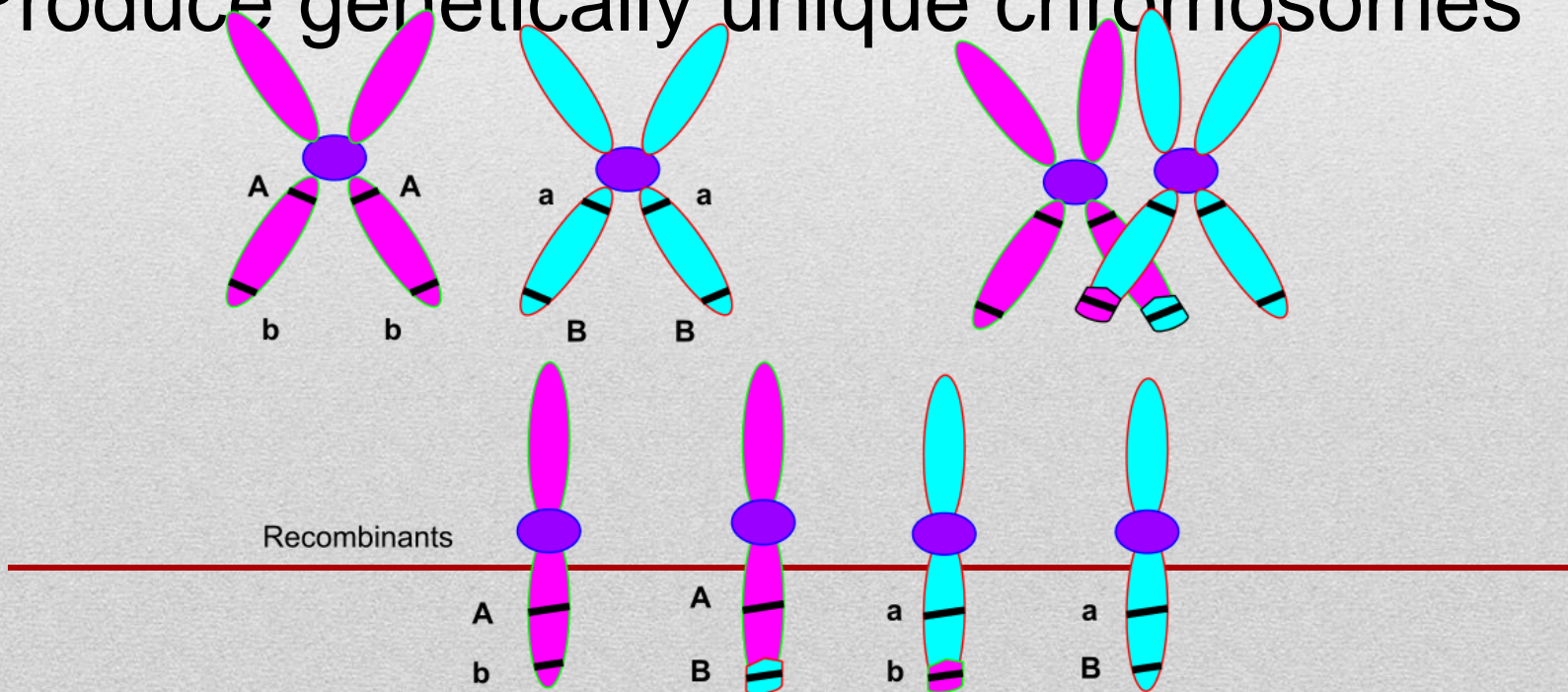


Crossing Over

Occurs during prophase 1.

Homologous pairs of chromosomes exchange DNA.

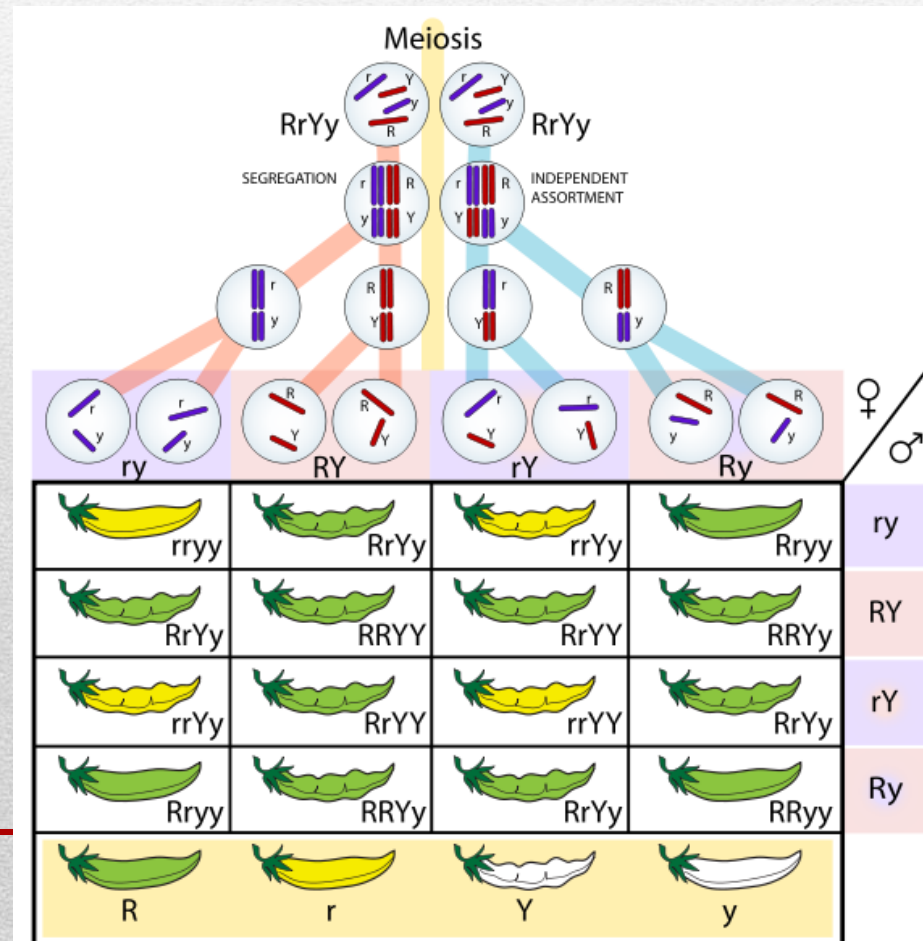
Produce genetically unique chromosomes



Independent Assortment

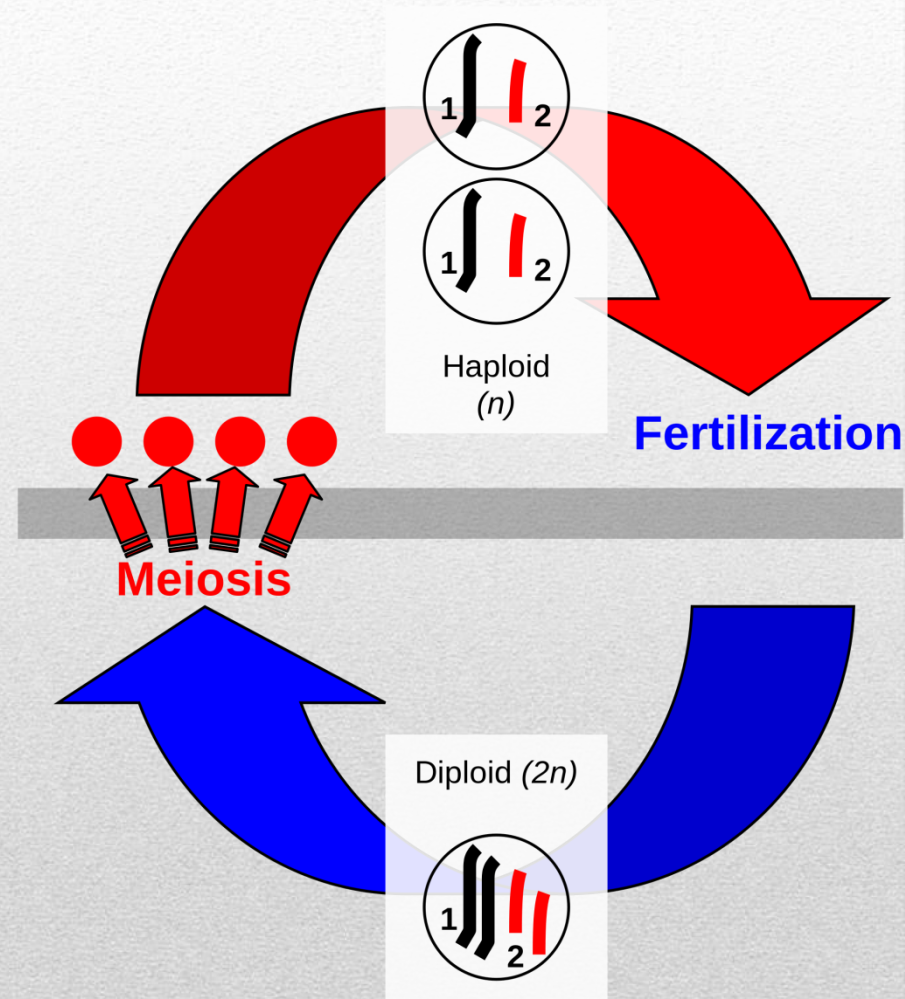
During metaphase 1, homologous pairs line up still attached.

The alignment of one pair has no effect on any other pair.



Meiosis, Sex, and Variation

The events of meiosis and the sexual life cycle generate a tremendous amount of variation. Every organism that is produced is genetically unique.



A Little Math

Variation due to **independent assortment**:

$2n$ (n = number of homologous pairs)
= ~8,000,000 possible combinations in
humans

Variation due to **fertilization**:

$(2n) \times (2n)$
= ~70,000,000,000,000 combinations in
humans.

Variation due to **crossing over**:

???