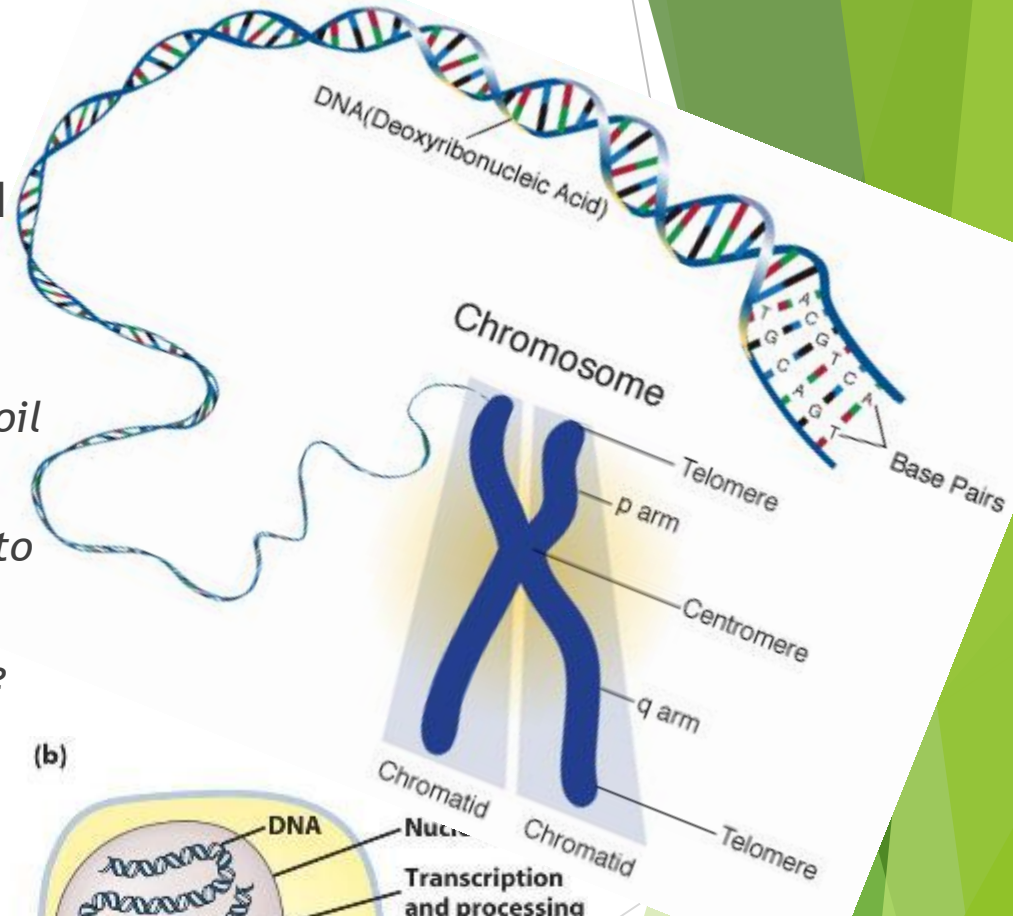
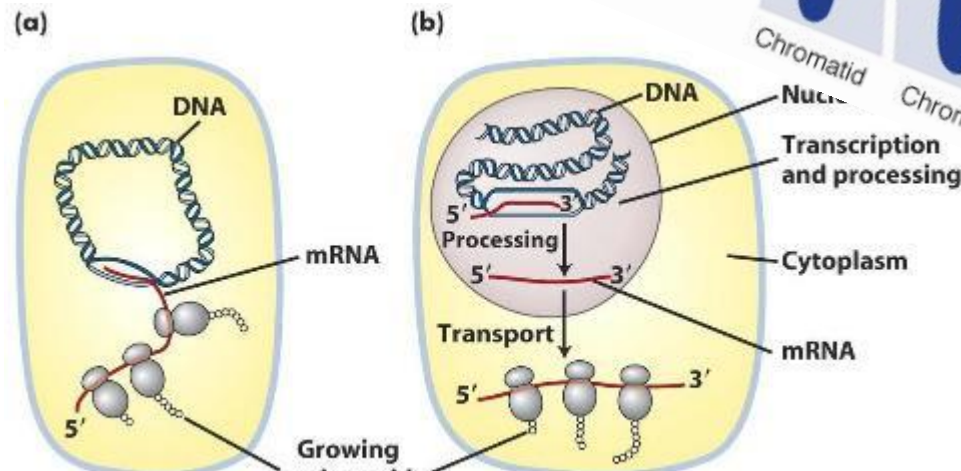


Unit 5: Cell Cycle & Division

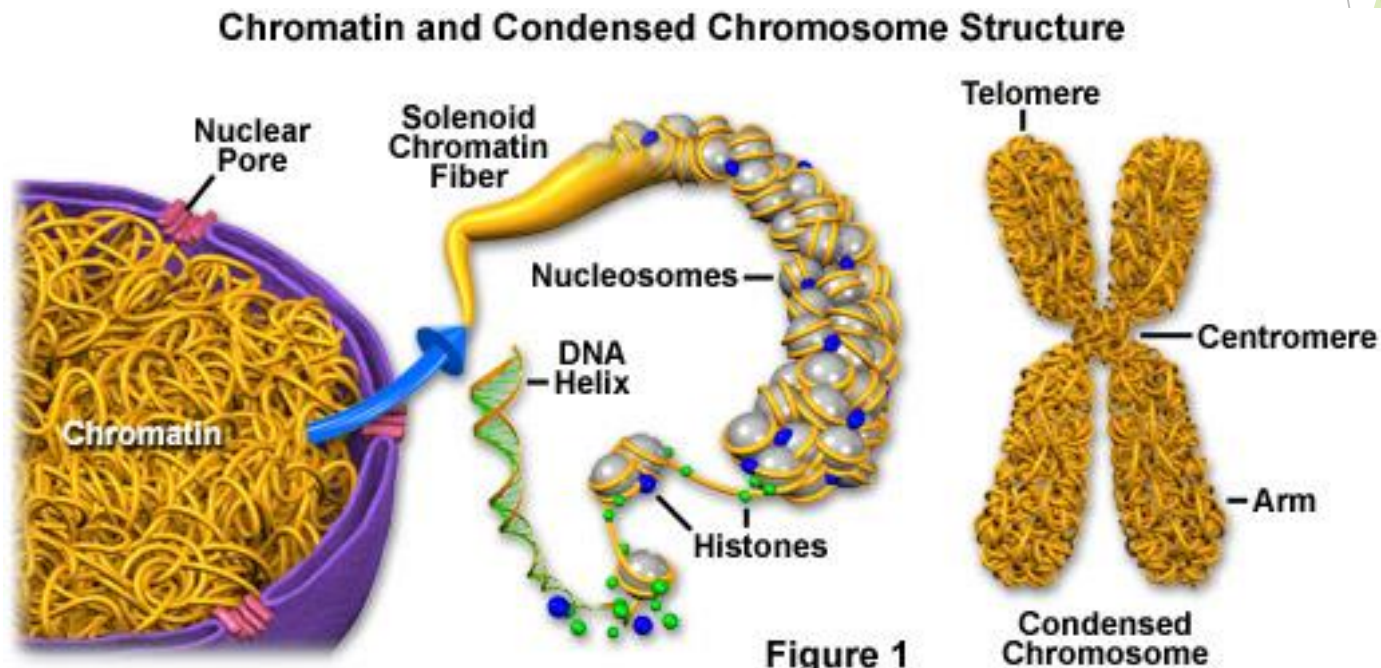
Topic 1: DNA Organization

- ▶ By the end of this topic, you should be able to...
 - ▶ Identify parts of a chromosome
 - ▶ Explain why DNA has to copy and coil before cell division
 - ▶ Explain why cells cannot continue to grow forever
 - ▶ Explain how prokaryotes reproduce (binary fission)



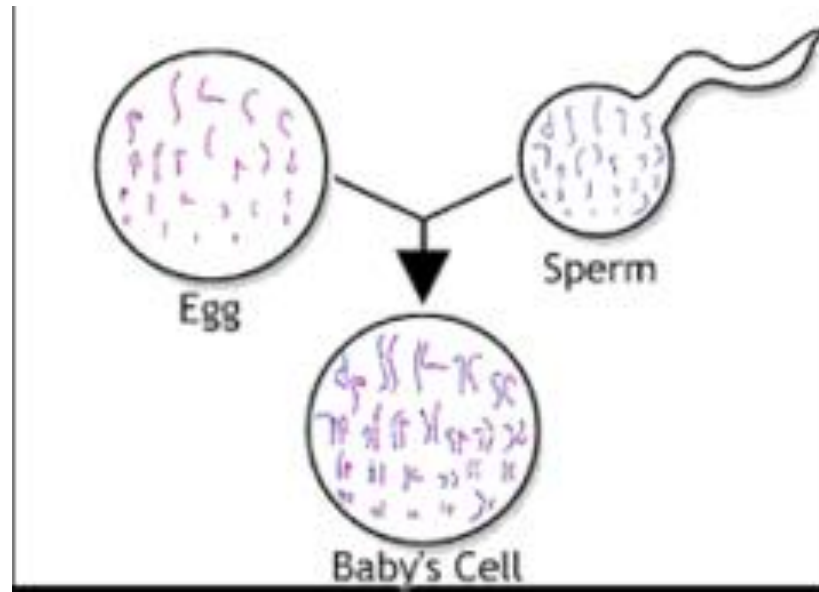
Organization of Genetic Material

- ▶ All the DNA in a cell constitutes the cell's **genome**
- ▶ A genome can consist of a number of DNA molecules
- ▶ DNA molecules in a cell are packaged into **chromosomes**



Organization Continued...

- ▶ Eukaryotic chromosomes consist of **chromatin**, a complex of DNA and protein that condenses during cell division
- ▶ Every eukaryotic species has a characteristic number of chromosomes in each cell nucleus
- ▶ Non-reproductive cells have two sets of chromosomes

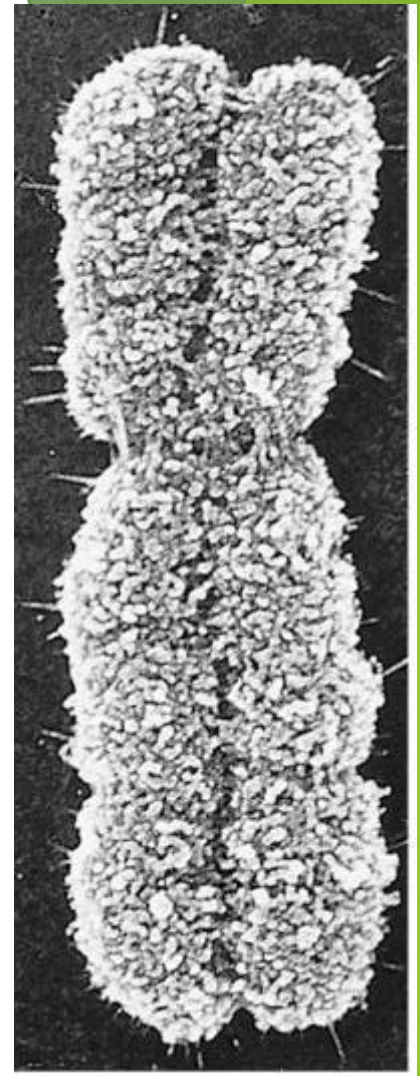
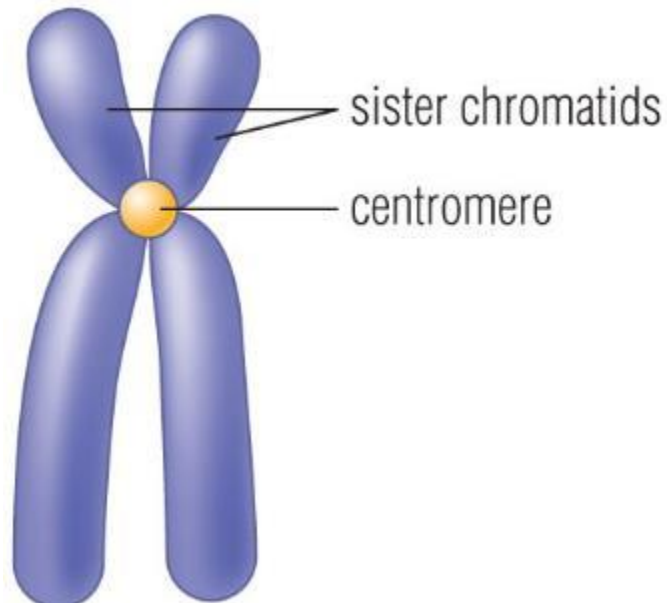


Chromosome number in various organisms

organism	Total number of chromosomes
Human	46
Cat	38
Dog	78
Pig	38
Goat	60
Sheep	54
Cattle	60
Horse	64
Donkey	62
Rabbit	44
Chicken	78

DNA Terms

- ▶ In preparation for cell division, DNA is replicated and the chromosomes condense
- ▶ Each duplicated chromosome has two **sister chromatids** which separate during cell division
- ▶ The **centromere** is where the two chromatids are most closely attached



To reproduce or not to reproduce,
that is the question.

-The Cell Cycle

Growth vs. Division

- ▶ When an animal or plant grows, what happens to its cells?
- ▶ Does an animal get larger because each cell increases in size (grows) or because it produces more of them?

Why can't cells grow forever?

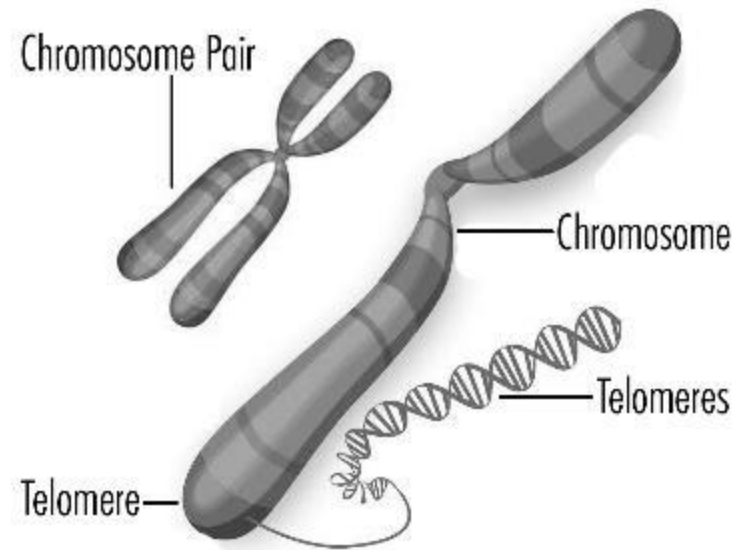
- ▶ **REASON 1:** Not enough DNA!...as the cell increases in size, it keeps the same amount of DNA. Eventually the cell will grow too much for the DNA to control all its activities

DNA Overload: when the DNA of a cell has too many tasks to do (like making proteins), and not enough DNA to get the job(s) done, the cell has “DNA overload” [cell size must be limited]

Every time a cell divides, the telomeres (ends of chromosomes) become smaller, so organisms age!

TELE-WHAT?

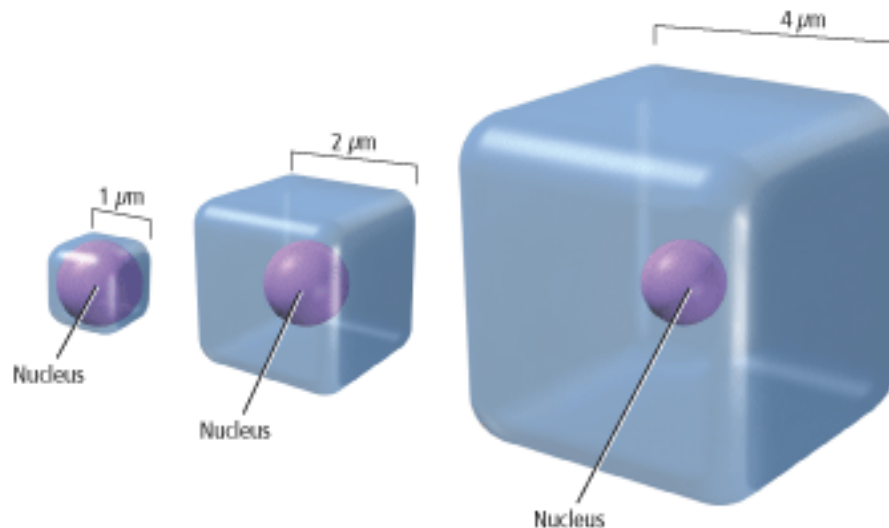
Telomeres are located at the end of a chromosome. Every time a cell divides, the telomere becomes smaller and ageing occurs. Telomeres continue to wear down until eventually they are damaged and the cell dies.



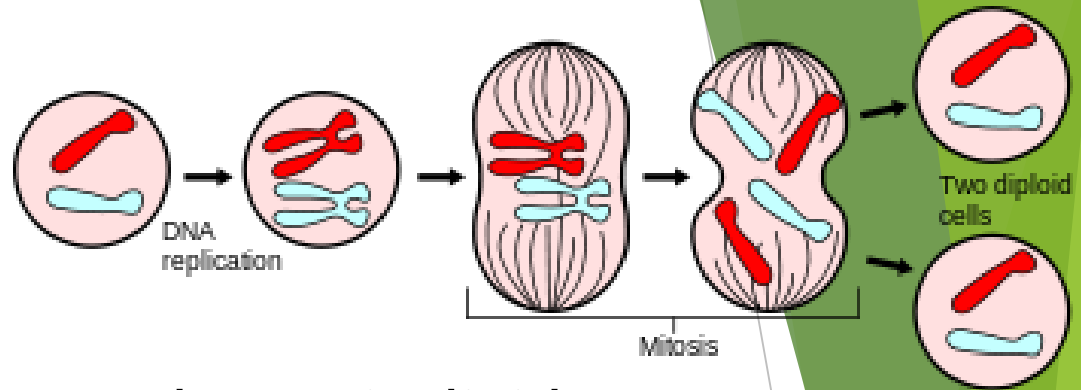
Why Can't Cells Grow Forever?

- ▶ **REASON #2:** Surface area of membrane doesn't increase as quickly as cell volume

Too little membrane → not enough exchange of materials in and out of the cell



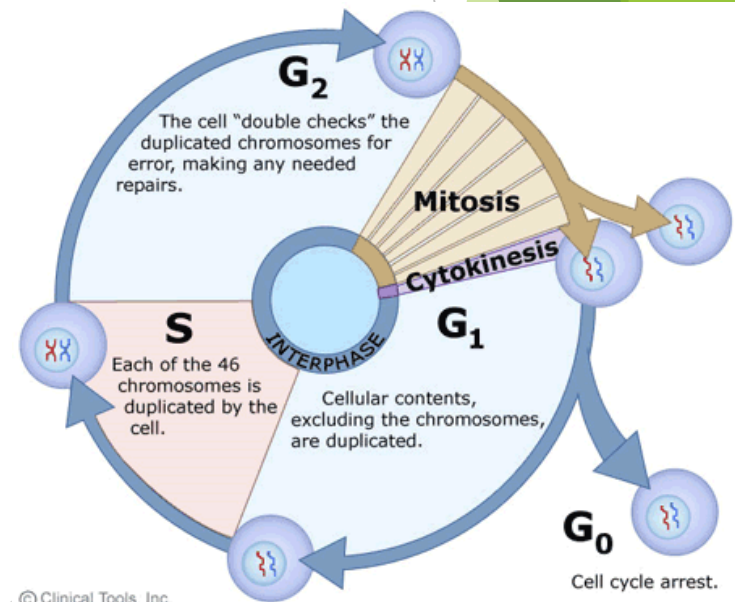
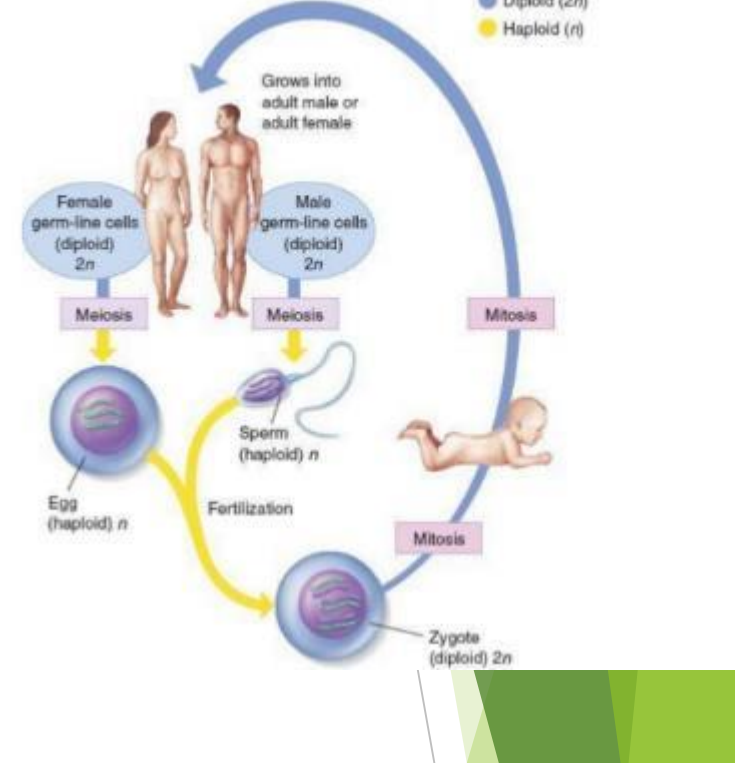
The Solution?



- ▶ Before a cell becomes too large, it divides to form 2 “**daughter cells**”.
- ▶ This process is called **cell division**
- ▶ Cell division can only happen once a cell has made a **copy of its DNA** so that each daughter cell can have a full genetic library

Why Divide?

- ▶ Multicellular organisms depend on cell division for
 - ▶ Development from a fertilized cell
 - ▶ Growth
 - ▶ Repair
- ▶ Cell division is an integral part of the **cell cycle**, the life of a cell from formation to its own division



Binary Fission in Bacteria

- ▶ Prokaryotes (bacteria and archaea) reproduce by a type of cell division called **binary fission**
- ▶ In binary fission, the DNA replicates (beginning at the **origin of replication**), and the two daughter chromosomes actively move apart
- ▶ The plasma membrane pinches inward, dividing the cell into two

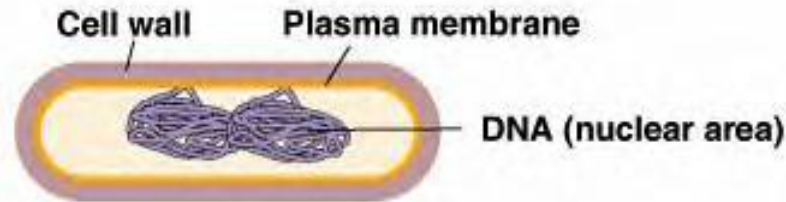
Reproduction

Binary Fission (*ASEXUAL*): cell parts reproduce and cell divides in half

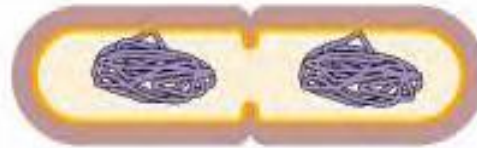
- The most common form of bacteria reproduction
- Produces genetically identical daughter cells

binary fission = bacteria divide

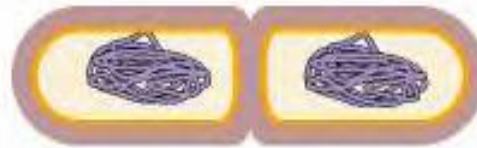
1 Cell elongates and DNA is replicated



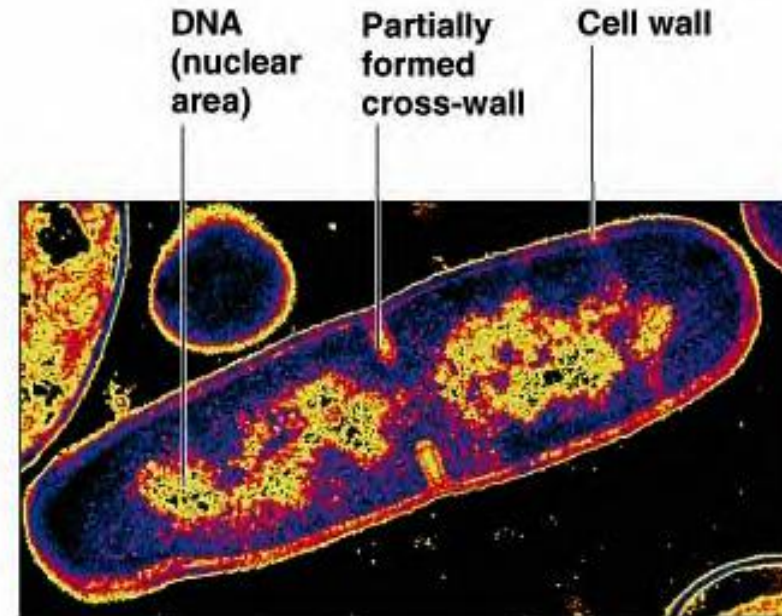
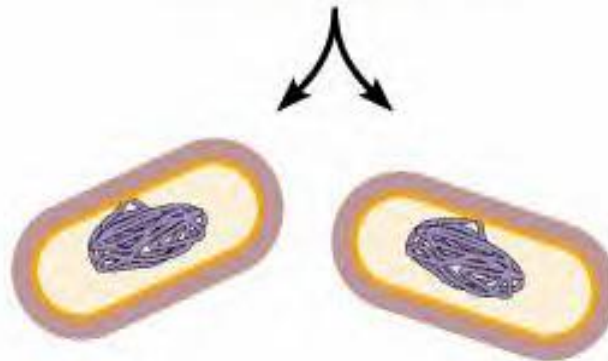
2 Cell wall and plasma membrane begin to divide



3 Cross-wall forms completely around divided DNA



4 Cells separate



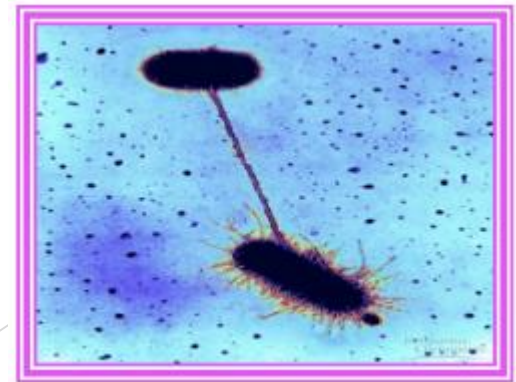
(b) A thin section of a cell of *Bacillus licheniformis* starting to divide.

(a) A diagram of the sequence of cell division.

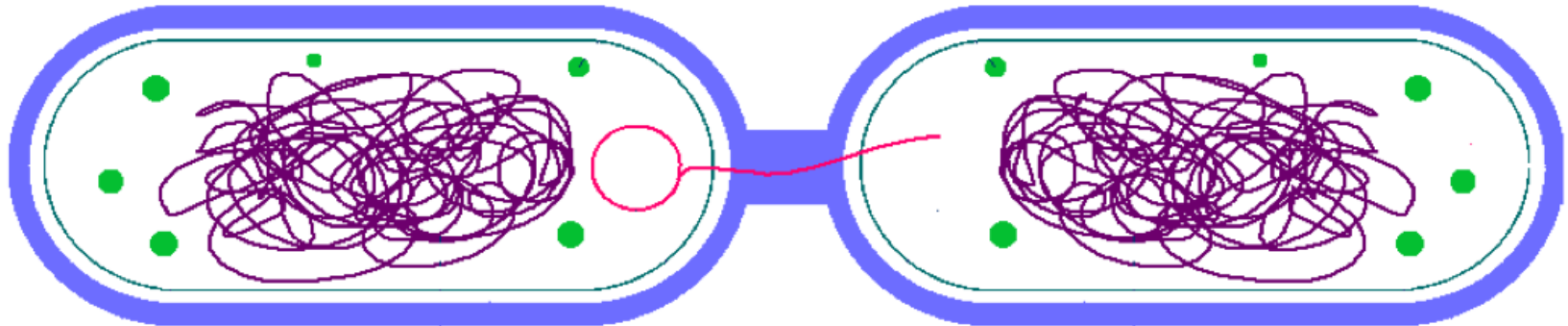
Conjugation (**SEXUAL**): exchange of genetic material (plasmid) between two bacterium

- One bacterium transfers the plasmid to the other bacterium through the conjugation bridge.
- This produces genetic diversity in bacteria that may ensure their survival. Can pick up resistance to antibiotics this way!

Bacterial conjugation
with a conjugation bridge



The **DOUBLE STRANDED** Plasmid **UNZIPS** and sends one strand to the other bacterium cell



The **Conjugation Bridge** breaks down and the bacterium separate

