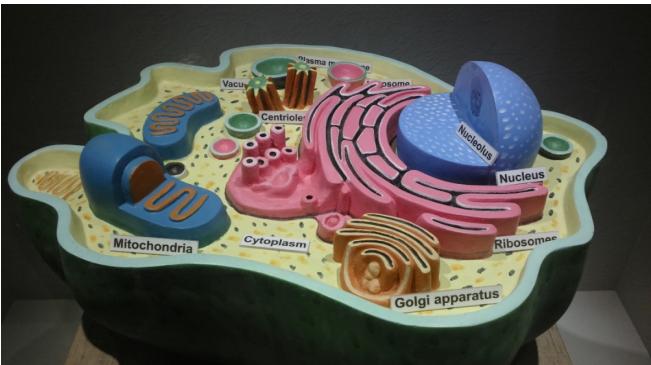


## **Tutorial -2**

### **Topic- Cell Cycle and Developmental Biology**

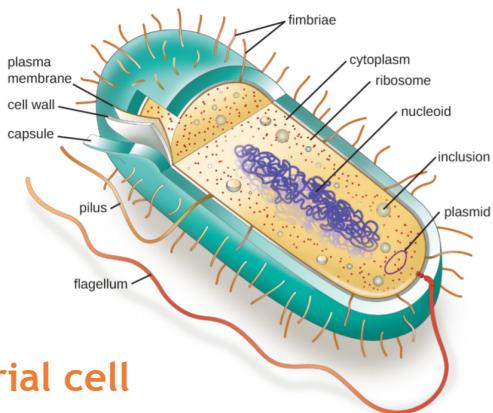
## Cell the basic unit of Life



Animal cell

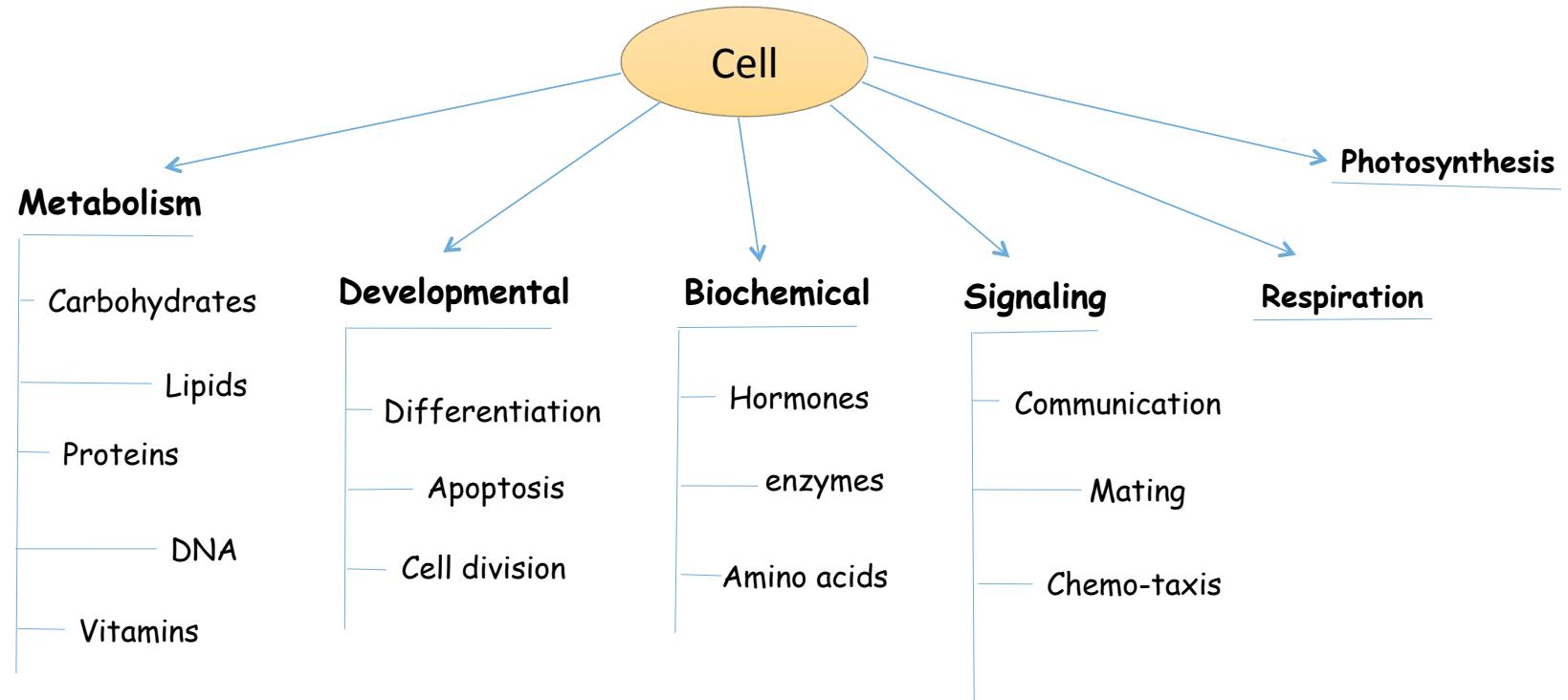


Plant cell

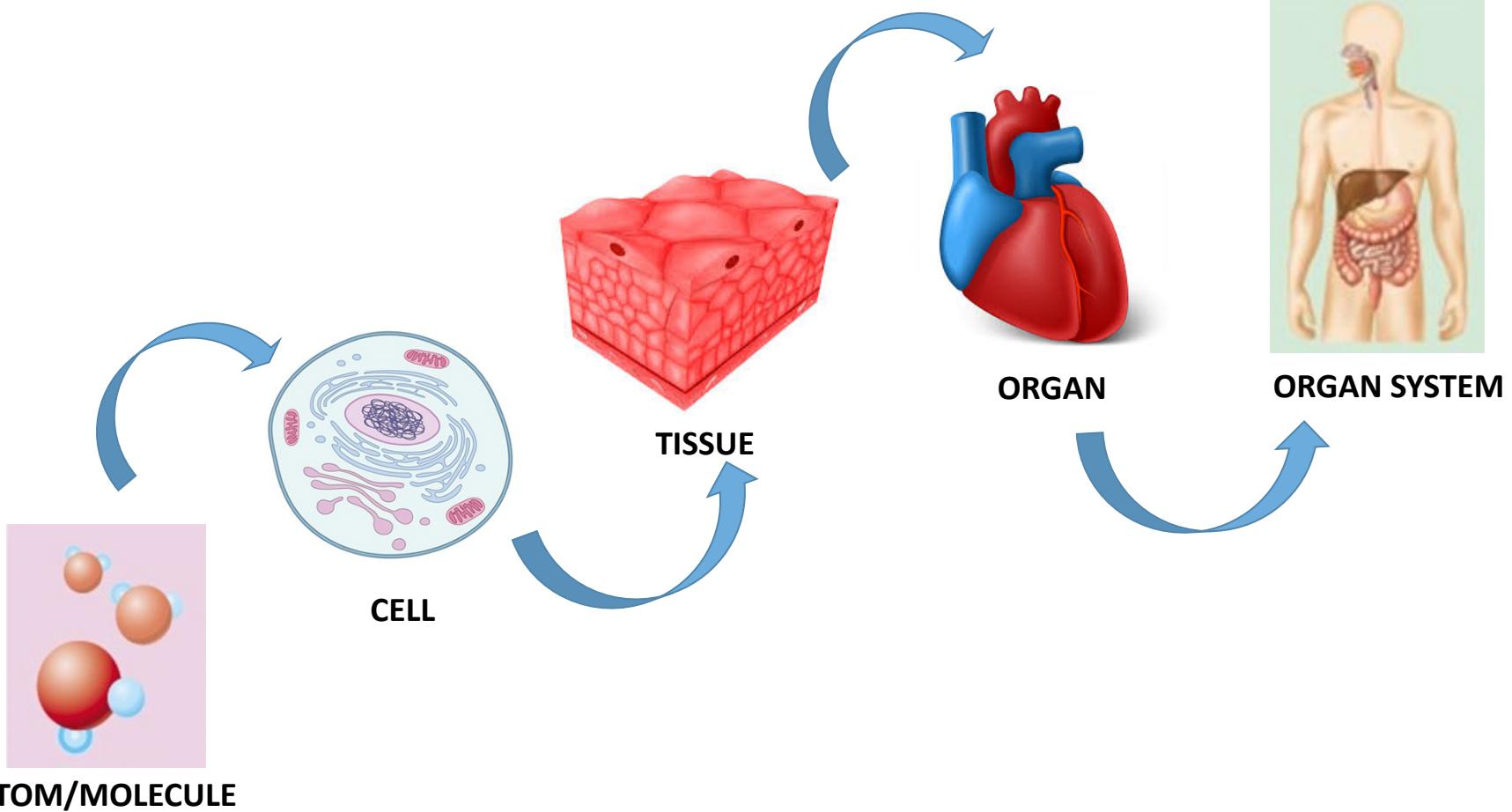


bacterial cell

A cell is multitasking ....!!



## Levels of Organization



## Multiplication of cells by division

Bacteria (Prokaryotic)

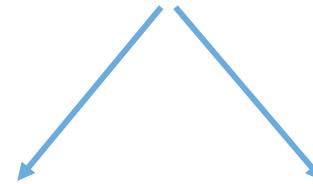


Binary Fission



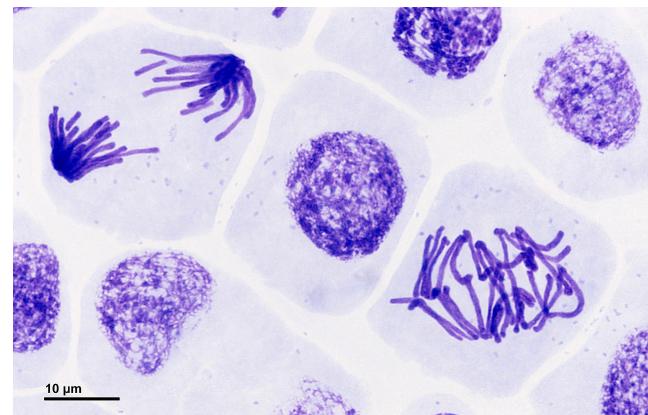
[www.cronodon.com](http://www.cronodon.com)

Animal/Plant cell (Eukaryotic)



Mitosis

Meiosis



[www.commons.Wikimedia.org](https://commons.wikimedia.org)

## Binary Cell Fission

- ✓ **Lower organisms** like Bacteria and Archaea follow this form of cell division to multiply

### Steps- DNA Replication

Elongation of cell

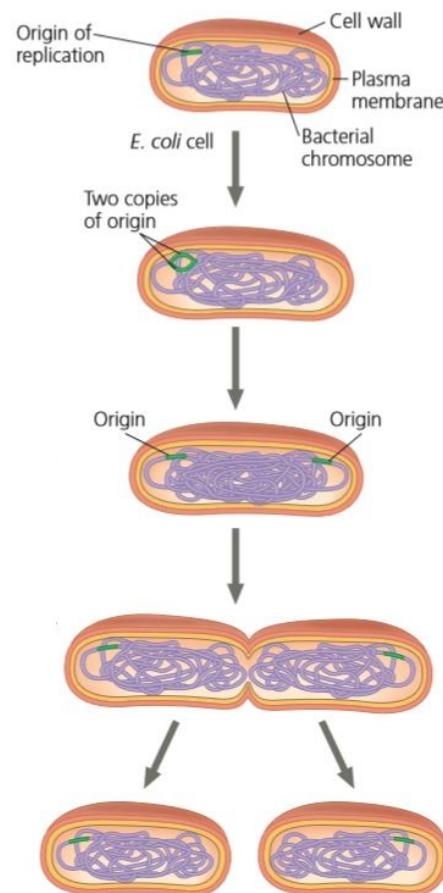
Splitting of other cell organelles

Cell wall Splitting giving rise to two small daughter cells

**Speed**-Binary fission is generally rapid though its speed varies between species.

For *E. coli*, cells typically divide about every 20 minutes at 37 °C.

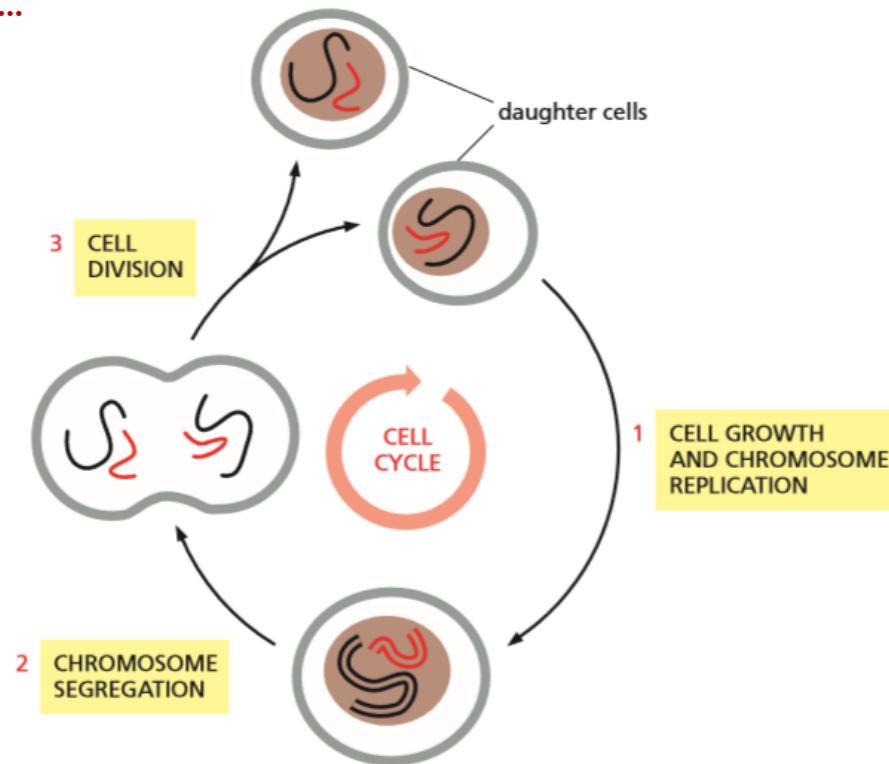
*Mycobacterium tuberculosis* may have doubling times of nearly 100 hours



Reece, Jane B., et al.

## What is CELL CYCLE?

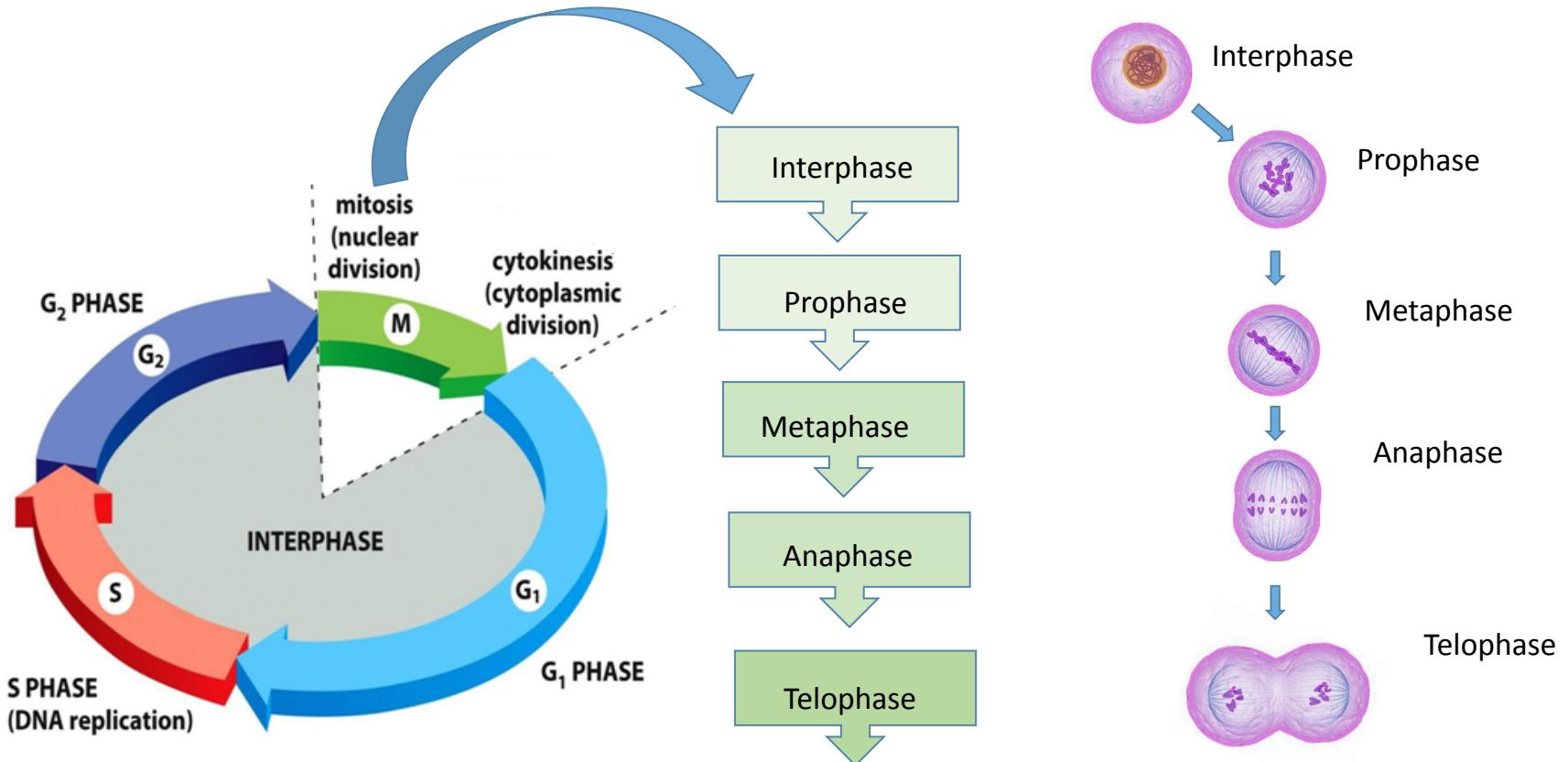
Life of a cell in simple terms.....



Life of a cell (Cell cycle) completes when it divides

Alberts, B. Molecular biology of the cell

## Overview of Mitosis



<http://lifeofplant.blogspot.in/2011/03/mitosis-and-meiosis.html>

## Interphase-The longest Phase

### G<sub>1</sub> phase

Cells increase in size in Gap 1. The G1 checkpoint control mechanism ensures that everything is ready for DNA synthesis.

### S phase

DNA replication occurs during this phase.

### G<sub>2</sub> phase

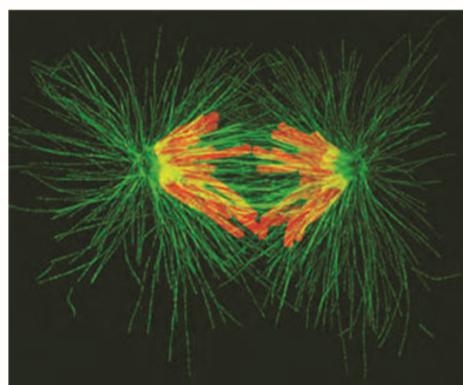
During the gap between DNA synthesis and mitosis, the cell will continue to grow. The G2 checkpoint control mechanism ensures that everything is ready to enter the M (mitosis) phase and divide.

### G<sub>0</sub> phase

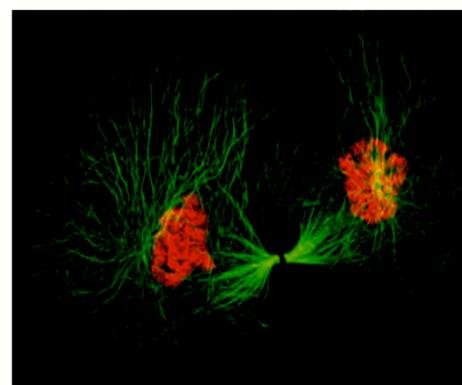
A phase where the cell has left the cycle and has stopped dividing.

## Guess the phases of Mitosis

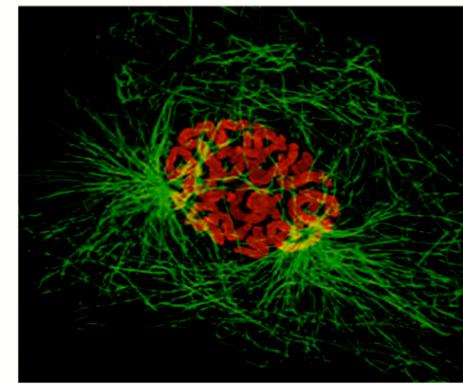
a.



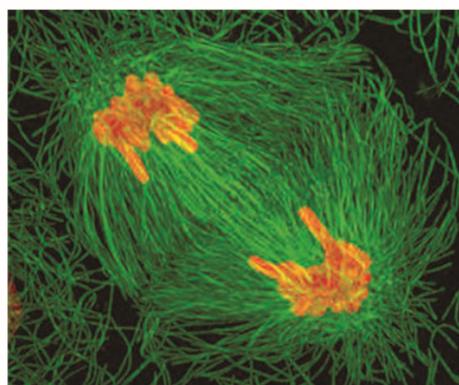
b.



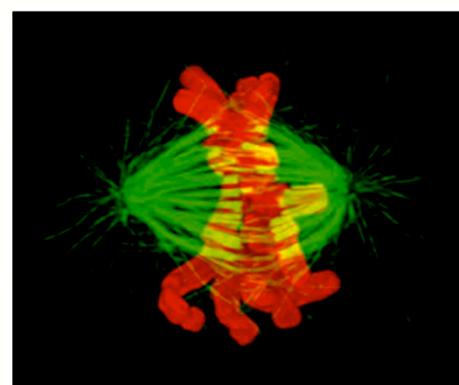
c.



d.

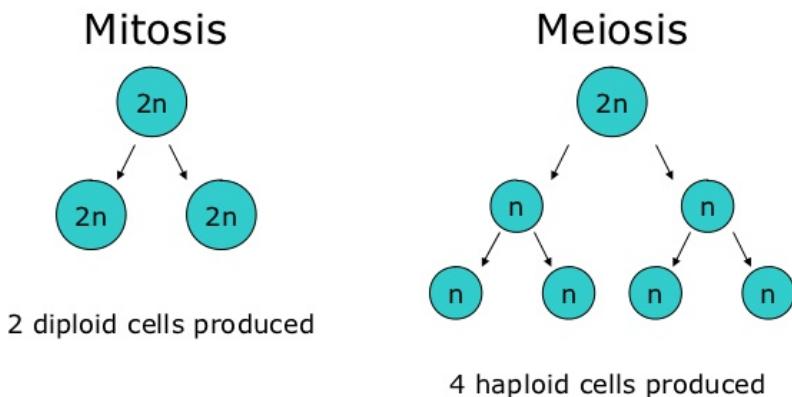
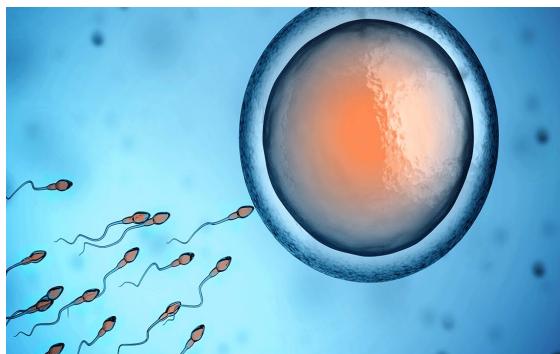


e.



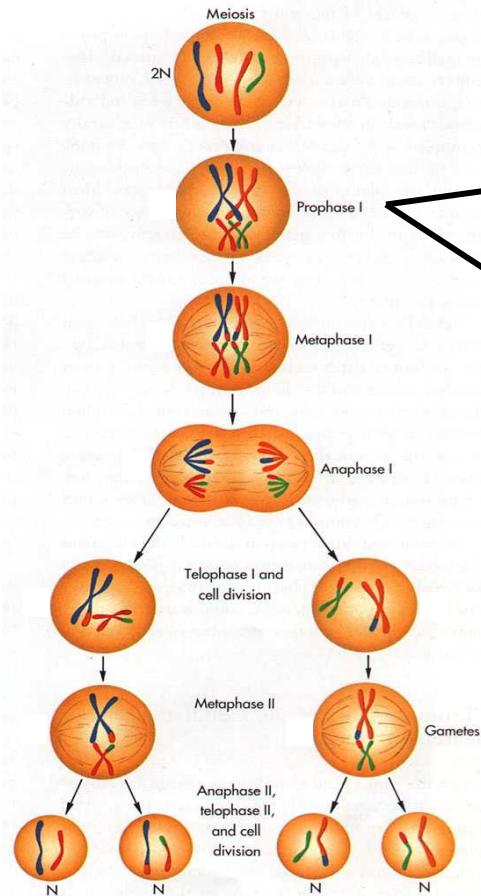
## Meiosis

- ✓ Meiosis is a specialized form of cell division that produces reproductive cells, such as plant and fungal spores, sperm and egg cells.

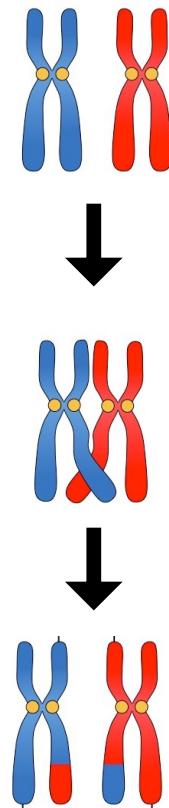


- ✓ **Meiosis is important** because it reduces the number of chromosomes by half allowing sexual reproduction to occur.
- ✓ It is also responsible for producing genetic variations during the process of recombination.

## Meiosis



**Chromosomal crossover** (or crossing over) is the exchange of genetic material between homologous chromosomes that results in recombinant chromosomes during sexual reproduction.



## Summary

### Comparison of Divisions

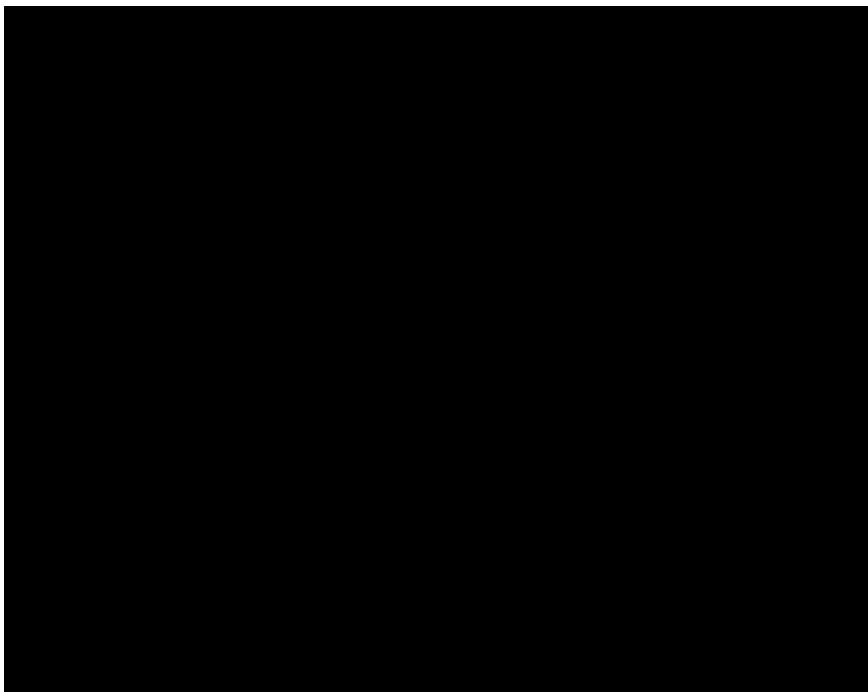
	Mitosis	Meiosis
Number of divisions	1	2
Number of daughter cells	2	4
Genetically identical?	Yes	No
Chromosome Number	Same as parent	Half of parent
Where?	Somatic cells	Germ cells
When?	Throughout life	During Gametogenesis
Role	Growth and repair	Maintenance of chromosome number

**State whether Mitosis or Meiosis will occur in following cases:**

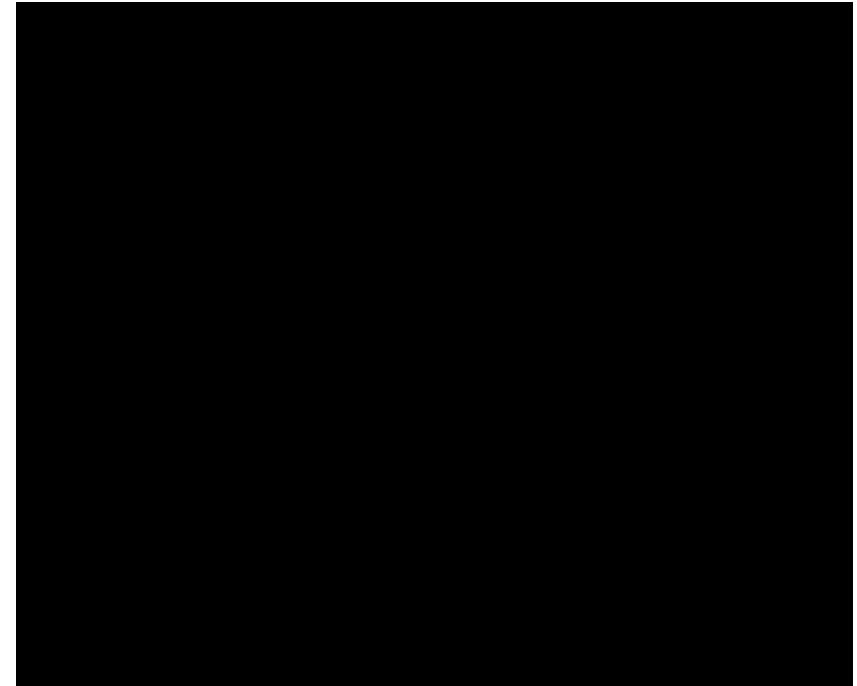
- Two divisions occur in one complete cycle                          ■ Meiosis
- Equatorial division    ■ Mitosis
- Two daughter cells are formed at the end of cell division                          ■ Mitosis
- The daughter cells produced are genetically different                          ■ Meiosis
- Division occurring in somatic cells                                    ■ Mitosis
- Responsible for maintenance of chromosome number                          ■ Meiosis

## Videos

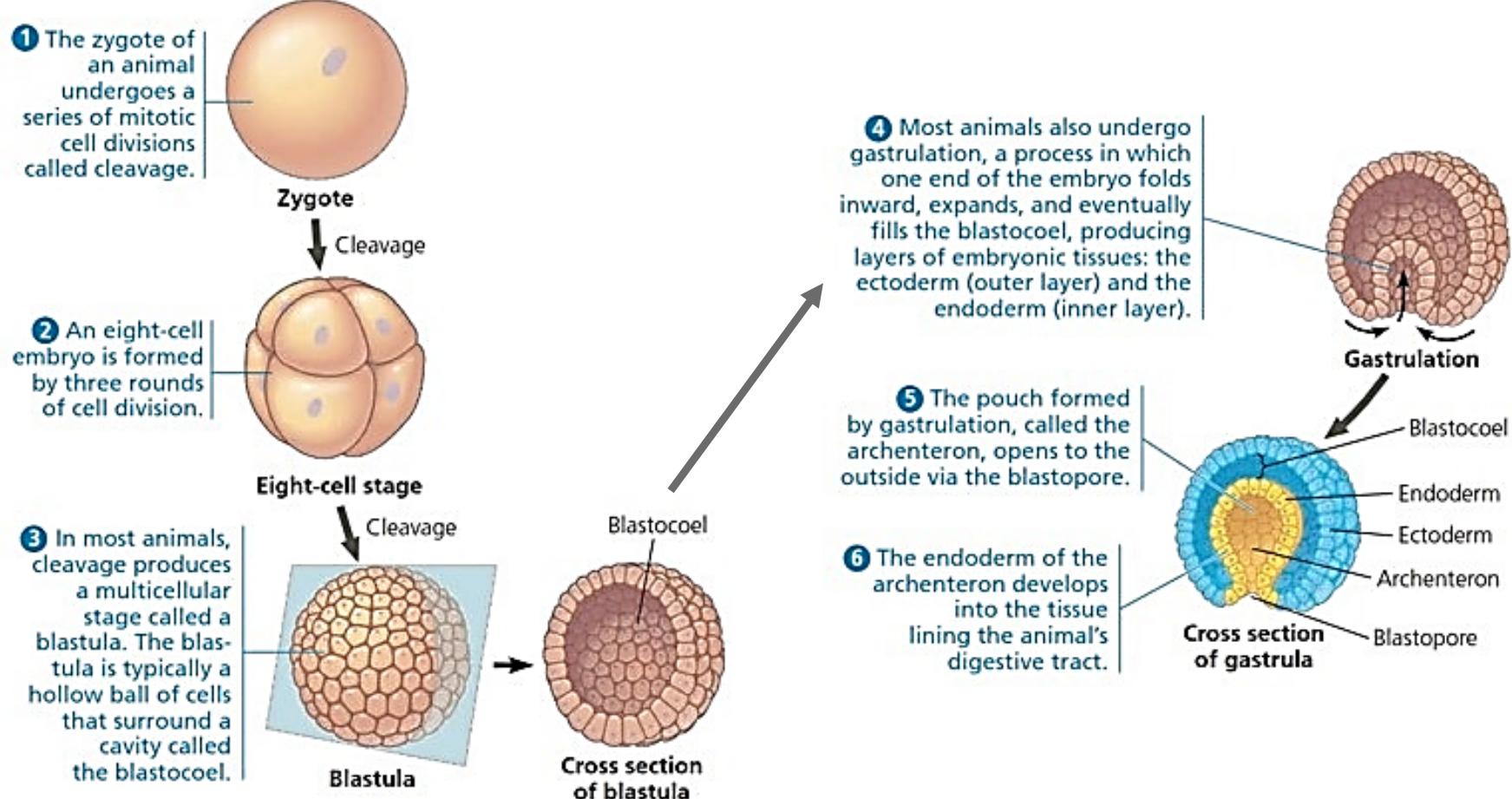
Mitosis



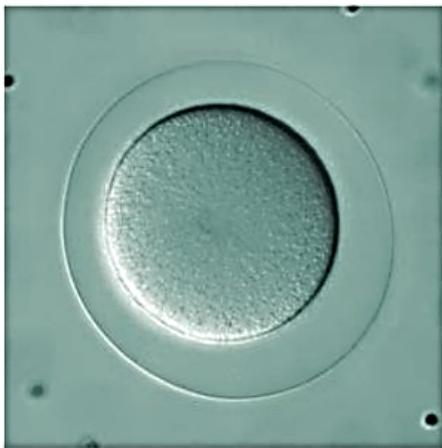
Meiosis



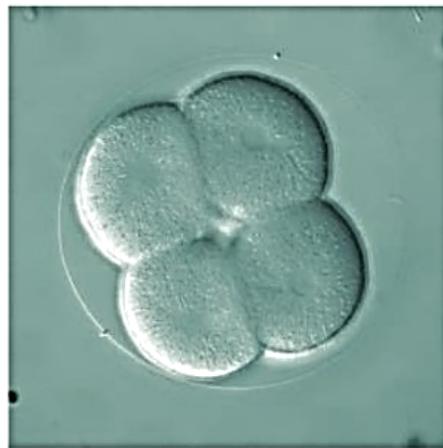
## Early embryonic development in animals



**Actual divisions!**



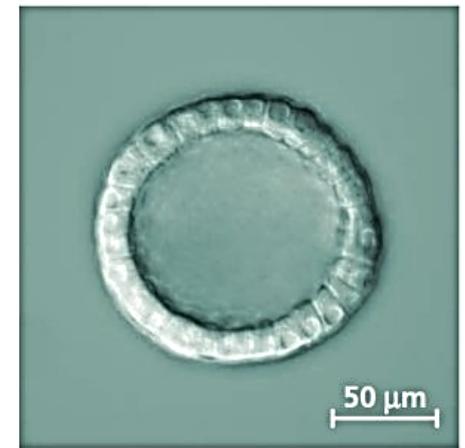
(a) Fertilized egg.



(b) Four-cell stage.



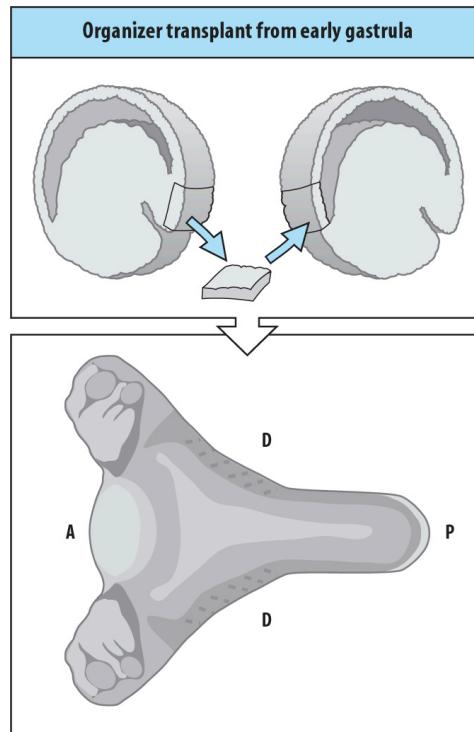
(c) Early blastula.



(d) Later blastula.

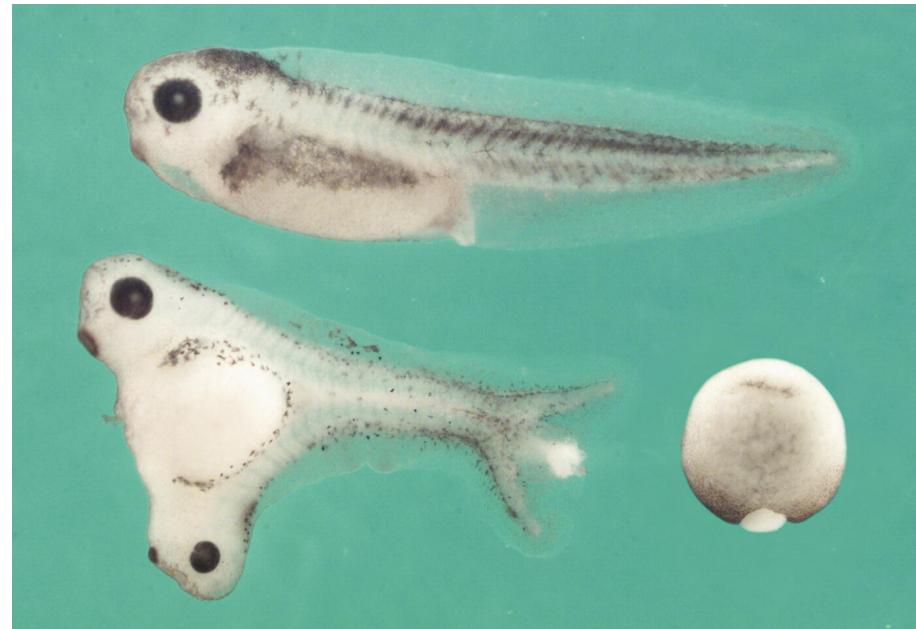
## Cell Fate

Differential gene expression by cells begin during development



Spemann–Mangold experiment

## Cell Fate

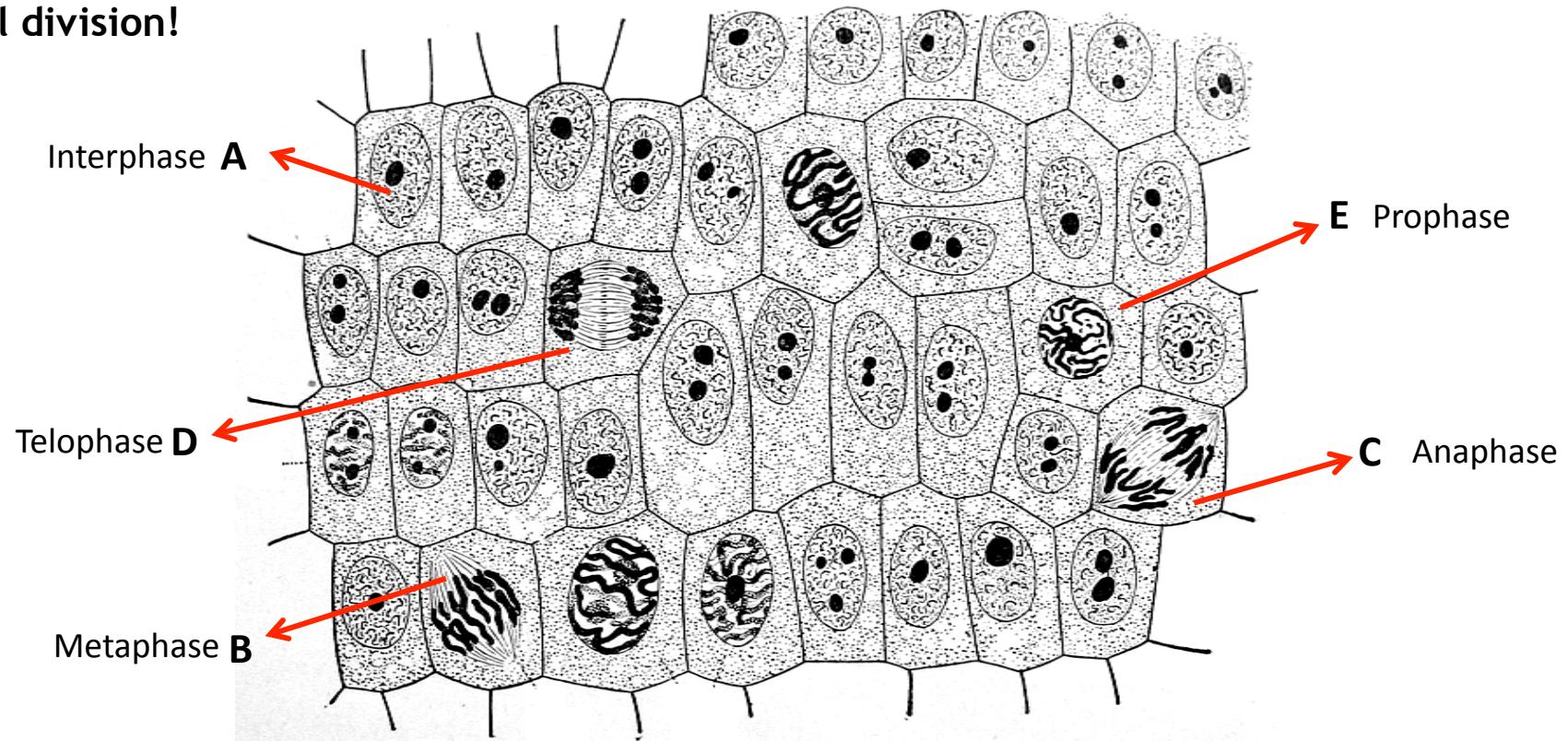


*Xenopus laevis* (a frog)

Spemann–Mangold experiment

## Questions

1. Try to identify all the phases of cell division!



## Questions

**2. A diploid cell in G1 has 6 chromosomes. How many chromosomes and Chromatids are present in each of the following stages**

- |    |           |
|----|-----------|
| G1 | Metaphase |
| G2 | Prophase  |
|    | Anaphase  |
|    | Telophase |

**3. Group the following cells according to cell division-**

*E.coli, liver cell, Ovum, Skin cell, Salmonella, Plasmodium, Algae, Sperm*

**Contd.**

4. Through a microscope, you can see a cell plate beginning to develop across the middle of a cell and nuclei forming on either side of the cell plate. This cell is most likely
  - a. an animal cell in the process of cytokinesis.
  - b. a plant cell in the process of cytokinesis.
  - c. a bacterial cell dividing.
  - d. a plant cell in metaphase.
  
5. One difference between cancer cells and normal cells is that cancer cells
  - a. are unable to synthesize DNA.
  - b. are arrested at the S phase of the cell cycle.
  - c. continue to divide even when they are tightly packed together.
  - d. cannot function properly because they are affected by density-dependent inhibition.
  
6. Which of the following does not occur during mitosis?
  - a. condensation of the chromosomes
  - b. replication of the DNA
  - c. separation of sister chromatids
  - d. spindle formation

**Contd.**

7. Many cells in the body divide only rarely, if at all; neurons, red blood cells, and keratinocytes are extreme examples. In which portion of the cell cycle would such cells be considered to be?

- a)** M phase
- b)** G1 phase
- c)** G0 phase
- d)** S phase
- e)** G2 phase

8. A fertilized egg is called a:

- a)** germ cell
- b)** embryo
- c)** zygote
- d)** blastula
- e)** oocyte

9. Genes control development by:

- a)** controlling where and when proteins are synthesized
- b)** containing small preformed body parts and organs that become "expressed" during development
- c)** directly controlling phenotypes, without intermediates or influence from the environment
- d)** acting as enzymes to build proteins
- e)** activating all proteins at all times

**Contd.**

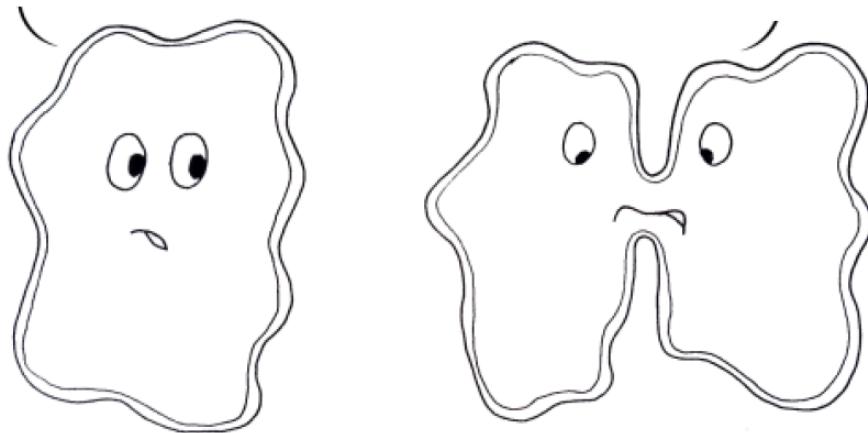
Match the following

- |                                |   |
|--------------------------------|---|
| a) Nucleus                     | 1) Protein production                     |
| b) Rough Endoplasmic reticulum | 2) Control center                         |
| c) Golgi apparatus             | 3) Modification and logistics of proteins |
| d) Mitochondrion               | 4) Intracellular digestion                |
| e) Chloroplast                 | 5) Power generation                       |
| f) Lysosome                    | 6) Organic synthesis using light          |

## CELL DIVISION

DON'T YOU FEEL  
WELL??

I FEEL DIVIDED



**Thank You !**

## References

- Reece, Jane B., et al. *Campbell Biology*. Tenth edition. Boston: Pearson, 2014.
- Alberts, B. Molecular biology of the cell (6th edition), 2015.
- [https://commons.wikimedia.org/wiki/  
File:Mitosis\\_\(261\\_10\)\\_Pressed;\\_root\\_meristem\\_of\\_Vicia\\_faba\\_\(cells\\_in\\_anaphase,\\_prophase\).jpg](https://commons.wikimedia.org/wiki/File:Mitosis_(261_10)_Pressed;_root_meristem_of_Vicia_faba_(cells_in_anaphase,_prophase).jpg)
- [http://cronodon.com/BioTech/Bacteria\\_Growth.html](http://cronodon.com/BioTech/Bacteria_Growth.html)