BT205 – Cell and Molecular Biology

Instructors – Dr. Shirisha Nagotu and Prof. Siddhartha Ghosh

Syllabus

Cell organization and subcellular structures; structure and properties of nucleic acids; organization of prokaryotic and eukaryotic genomes; mechanisms of DNA replication; mechanism of DNA recombination;

transcription, eukaryotic RNA splicing and processing; translation; regulation of gene expression; cell signaling; programmed cell death; oncogenes; genes in differentiation and development.

Course content in Red – Dr. Nagotu
Course content in black – Prof. Ghosh

Text Books

•D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 6th Ed., Macmillan Worth, 2012.
•B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter, Molecular Biology of the Cell, 6th Ed., Garland Publishing, 2015.
•H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, M. P. Scott, A Bretscher, H. Ploegh, and P. Matsudaira, 6th Ed., W. H. Freeman & Co., 2007

RULES / INSTRUCTIONS

1. Attendance
2. Coming late
3. Talking and disturbing
4. Questions

EVALUATION

- Quiz 1 – 10 M (Tentative date -18th August)

- Midsem – 40 M

CELLS

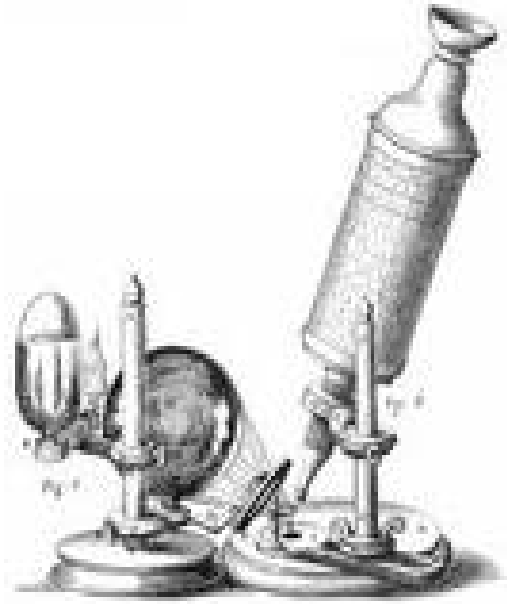
Two interesting themes in biology

- astonishing variety in individual features
- astonishing constancy in fundamental mechanisms

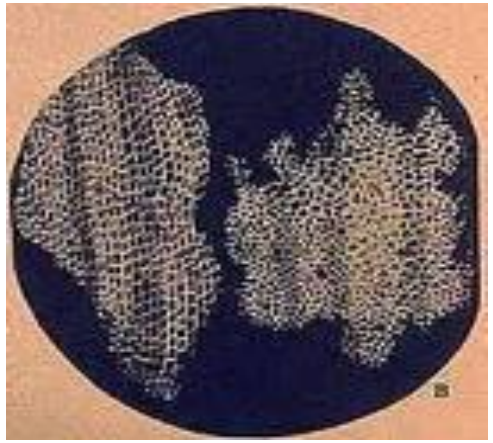
The cell is not only the structural, physiological, and developmental, but also the reproductive unit of life.

History of the Cell

Robert Hooke



Hooke's cells



1865
(Micrographia)

Anton van Leeuwenhoek's microscope from the 17th century with a magnification of 270x

Animalcules

Living cells

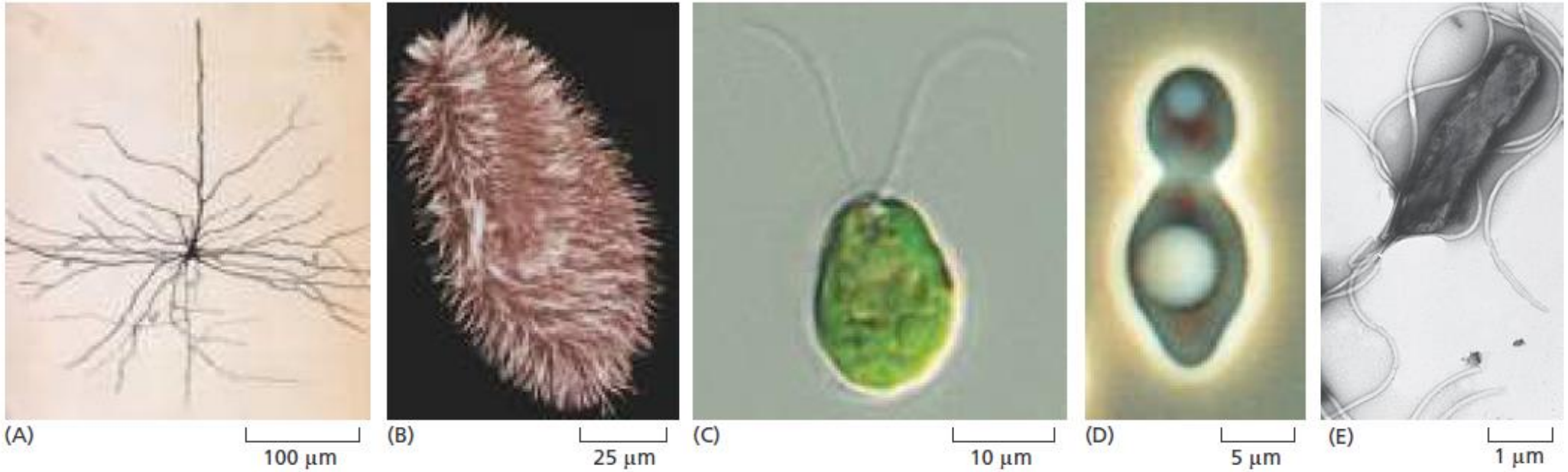
Father of Microbiology

Matthias Schleiden and Theodore Schwann proposed the cell theory

1. All living organisms are composed of one or more cells.
2. The cell is the basic unit of structure and organization in organisms.
3. Cells arise from pre-existing cells.


OLYMPUS
CBH
OLYMPUS
DP90
OLYMPUS
IX83

Cells vary enormously in size and shape



Nerve cell | Paramecium | Chlamydomonas | Yeast | *Helicobacter pylori*

Chemical requirements

Cells are also enormously diverse in their chemical requirements.

- Some require oxygen to live; for others this is deadly.

- Some cells consume little more than air, sunlight, and water as their raw materials;

Others need a complex mixture of molecules produced by other cells.

Cell also vary enormously in function

- These differences in size, shape, and chemical requirements often reflect differences in cell function.
- Some cells are specialized factories for the production of particular substances, such as hormones, starch, fat, latex or pigments.
- Others are engines, like muscle cells that burn fuel to do mechanical work.

- In a multicellular organism, however, there is a division of labor among cells, allowing some cells to become specialized to an extreme degree for particular tasks and leaving them dependent on their fellow cells for many basic requirements.

Cells similar to one another – in fundamental ways

- Cells resemble one another to an astonishing degree in the details of their chemistry.
- They are composed of the same sorts of molecules, which participate in the same types of chemical reactions .
- In all organisms, genetic information—in the form of *genes*—is carried in DNA molecules.

- This information is written in the same chemical code
- constructed out of the same chemical building blocks
- interpreted by essentially the same chemical machinery and
- replicated in the same way

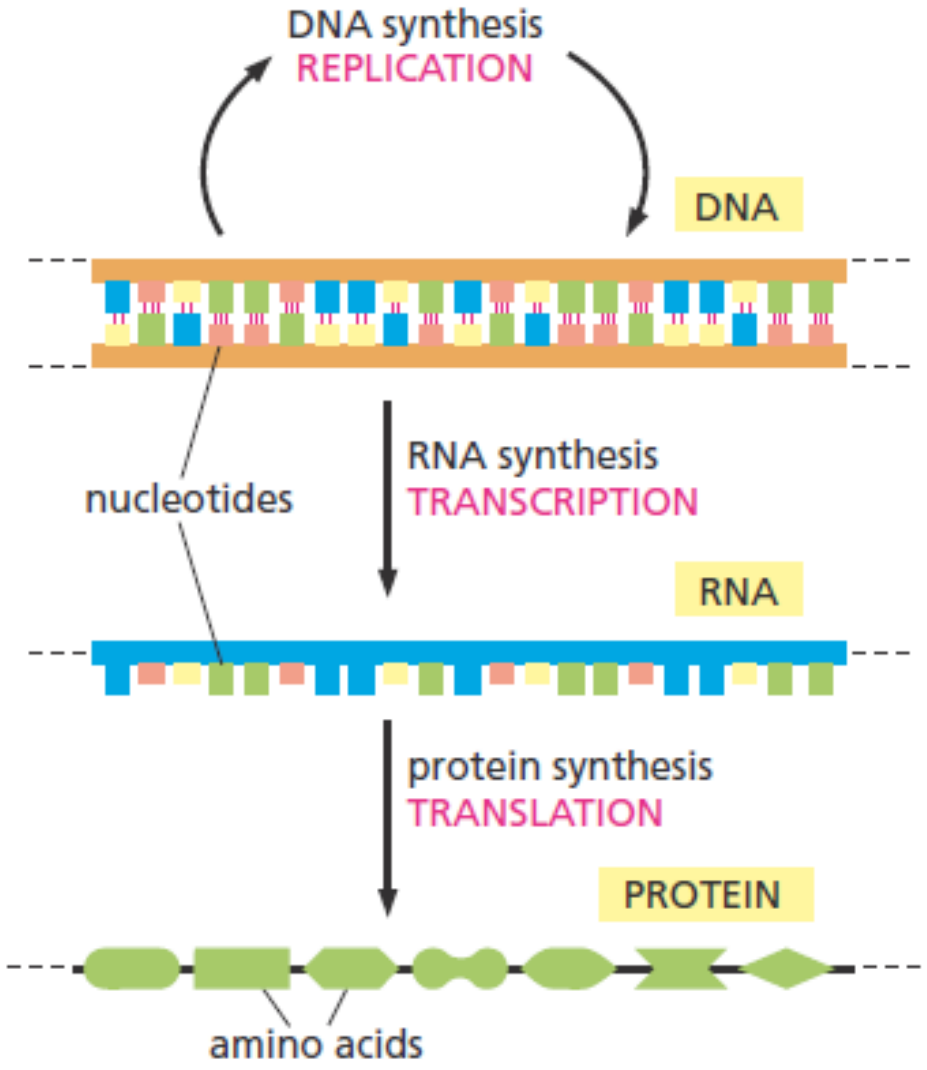
FLOW OF GENETIC INFORMATION –THE CENTRAL DOGMA

Thus, in every cell, the long DNA polymer chains are made from the same set of four monomers, called *nucleotides*, strung together in different sequences

In every cell, the information encoded in the DNA is read out, or *transcribed*, into a chemically related set of polymers called RNA.

A subset of these RNA molecules is in turn *translated* into yet another type of polymer called a protein.

This flow of information—from DNA to RNA to protein—is so fundamental to life that it is referred to as the *central dogma*



The appearance and behavior of a cell are dictated largely by its protein molecules, which serve as structural supports, chemical catalysts, molecular motors, and so on.

Proteins are built from *amino acids*, and all organisms use the same set of 20 amino acids to make their proteins.

But the amino acids are linked in different sequences, giving each type of protein molecule a different three-dimensional shape, or *conformation*,