

# **Biotechnology: Excitements and Career Opportunities**

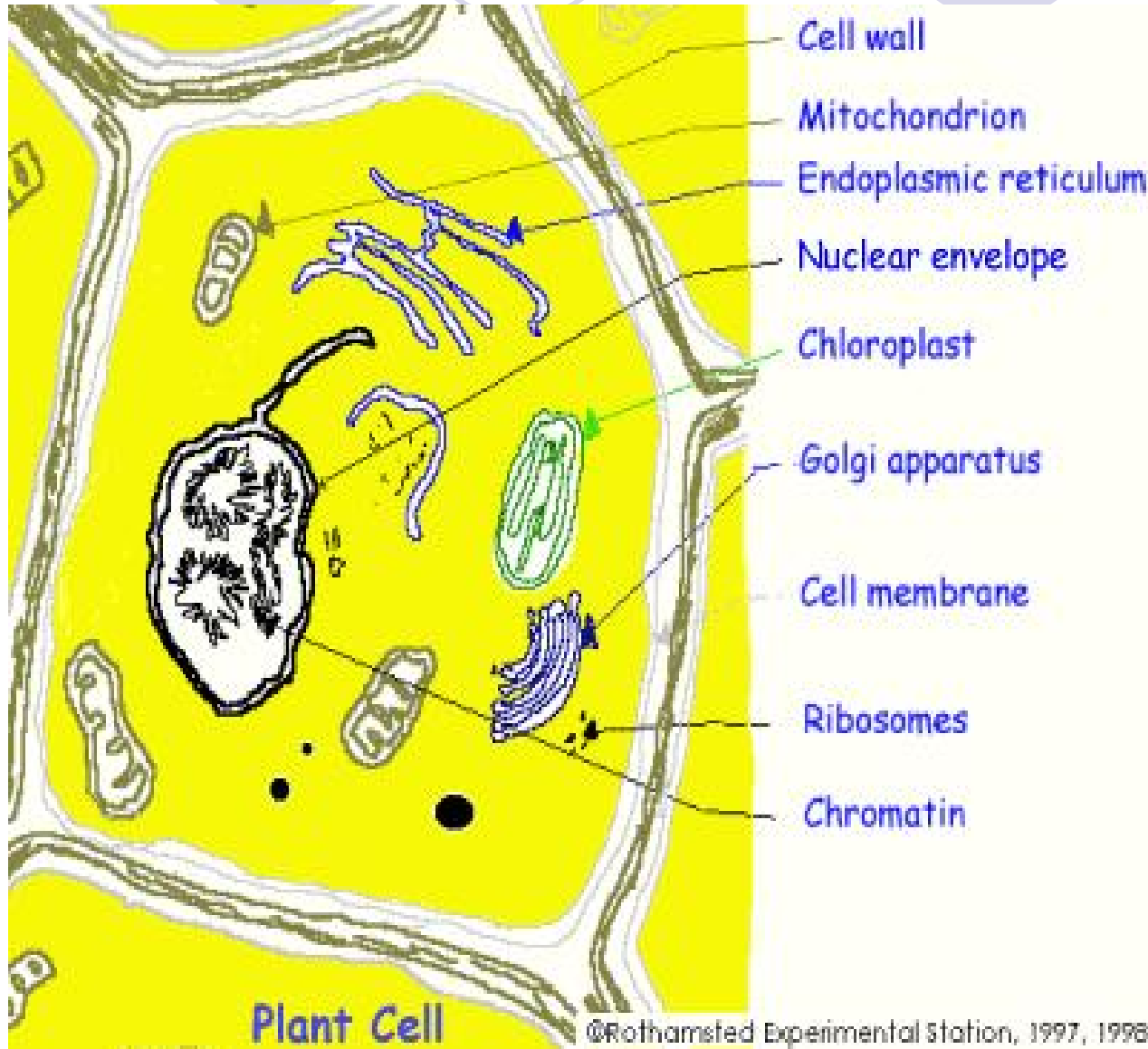
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# Definition of Biotechnology

- Use of cells (or parts of cells :enzymes, metabolites) for the welfare of mankind.
- Product formation in a predictable manner based on our understanding of the biological phenomenon.
- Application of engineering principles for design, scale-up

# Cell as a reactor



- Cell Growth
- Carrying out different reactions in crowded environments....?
- How do reactants of a particular pathway find their enzymes?
- Synthesizing DNA,RNA etc.
- Proteins being targeted to correct destinations
- Communicating with the environment
- autoregulating

# Cellular Molecules



## Non-informational molecules

- **Carbohydrates:** the main source of cellular energy, and also structural components of cells, cell-cell recognition
- **Lipids :** Bipolar molecules whose configuration accounts for many of the biological membrane's properties. Some hormones (steroids ) are derived from lipids

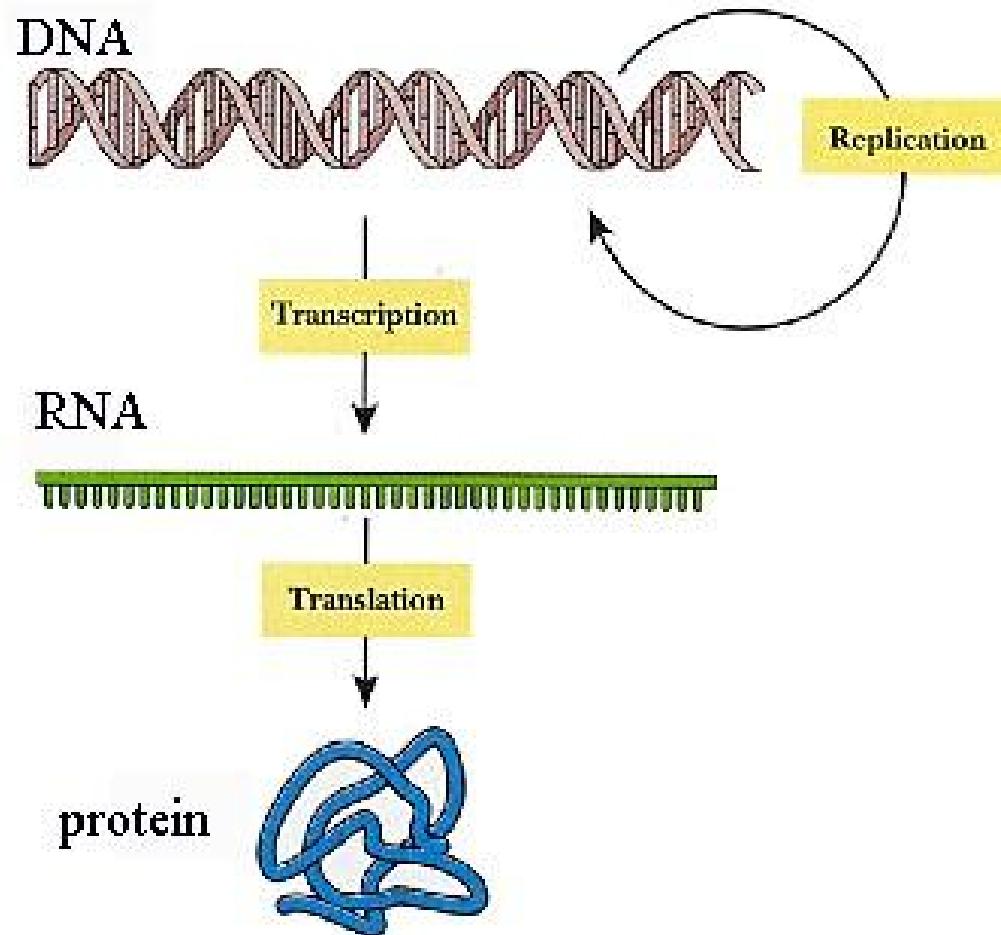
## Informational molecules

- **Nucleic acids :**  
[DNA](#), [RNA](#) .

**DNA -->(transcription)--> RNA--> (translation) --> Proteins**

- **Proteins:** Built up from [amino acids](#) , they are the working parts of the whole enzymes, receptors, channels, pores, hormones, ....

# Information Processing in Biological Systems



**Study of single genes at a time.**

# Genomics



## The Human Genome Project

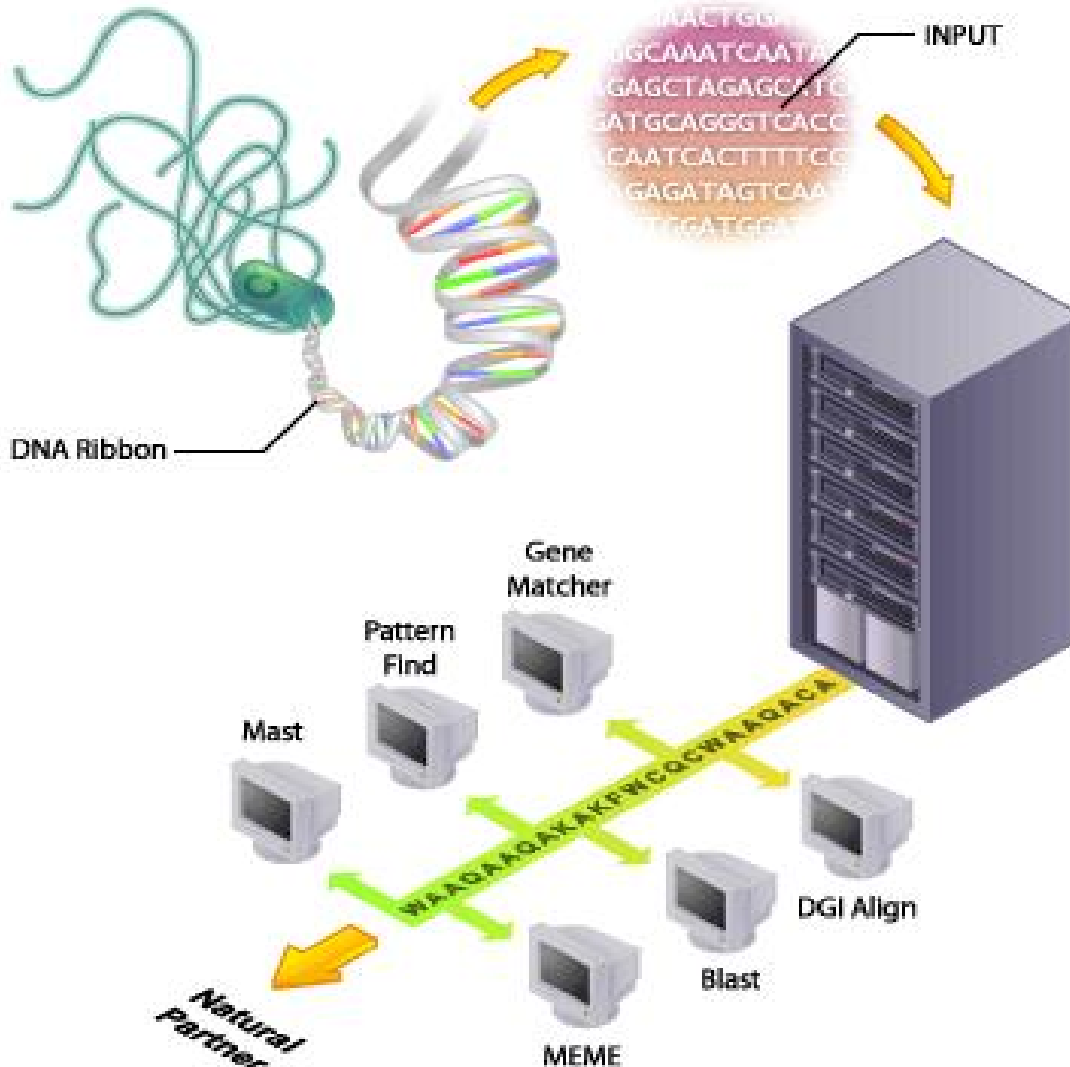
National  
Human  
Genome  
Research  
Institute, NIH

- to understand the genomes of humans and other organisms, will lead to unprecedented advances in science and medicine.
- Individual variations in the human genome can have a major impact on disease, environmental insults, drugs, and other therapies.

# Genomics and Drug Discovery

- Identify unique genes in infectious and pathogenic organisms for which there is no parallel with the human organisms-  
**Bioinformatics**
- Use these proteins as drug targets-  
**Molecular Modeling**
- Find out which genes have gone haywire in, say, cancer cells and use this information to develop specific drugs-  
**Microarray Technology**

# Bioinformatics

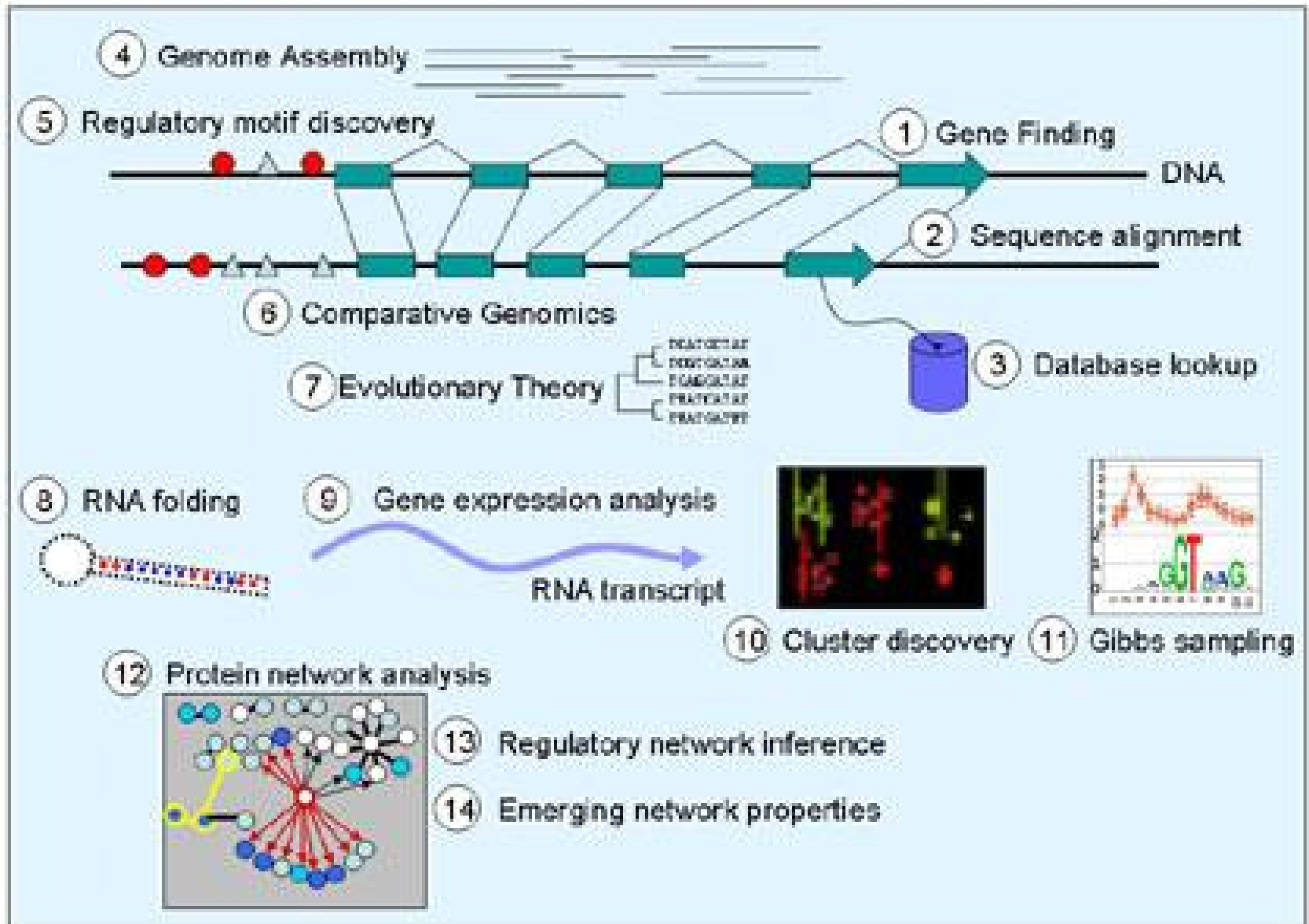


**Bioinformatics involves the integration of computers, software tools, and databases in an effort to address biological questions**

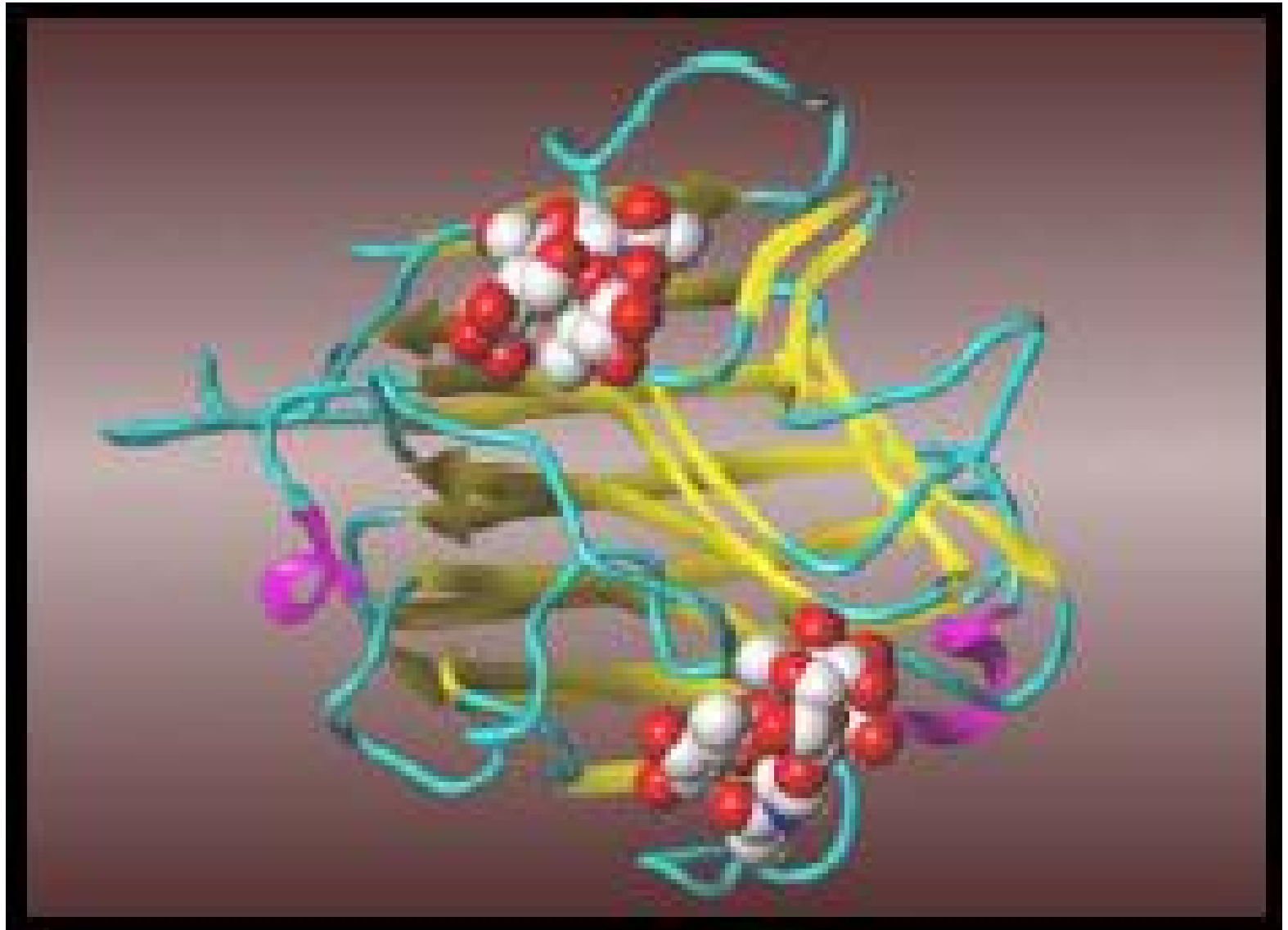
**Very quickly, you can compare genomes, predict genes, identify crucial differences in different cells**

**Classify gene expression etc.**

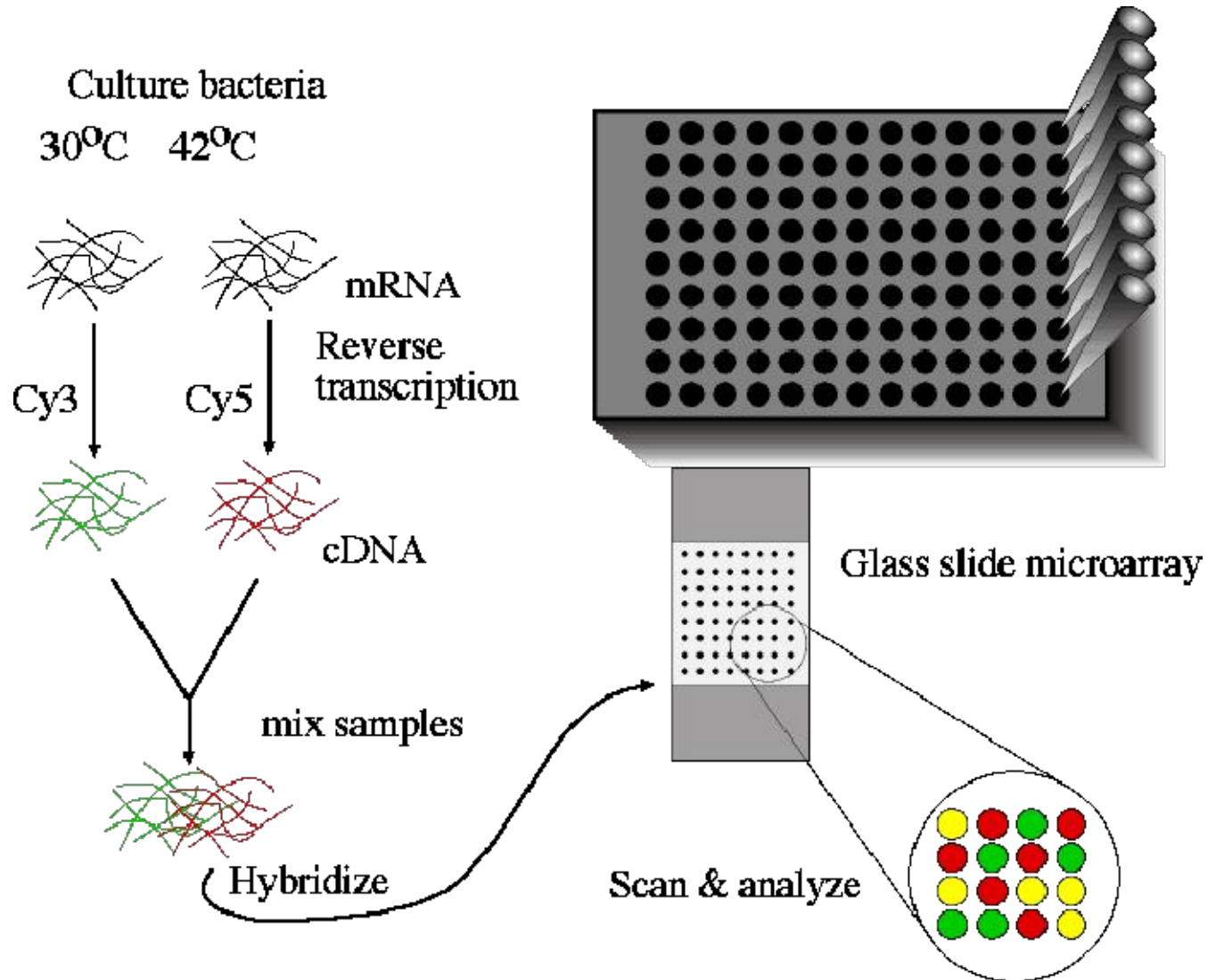
# Bioinformatics Activities



# Molecular Modeling

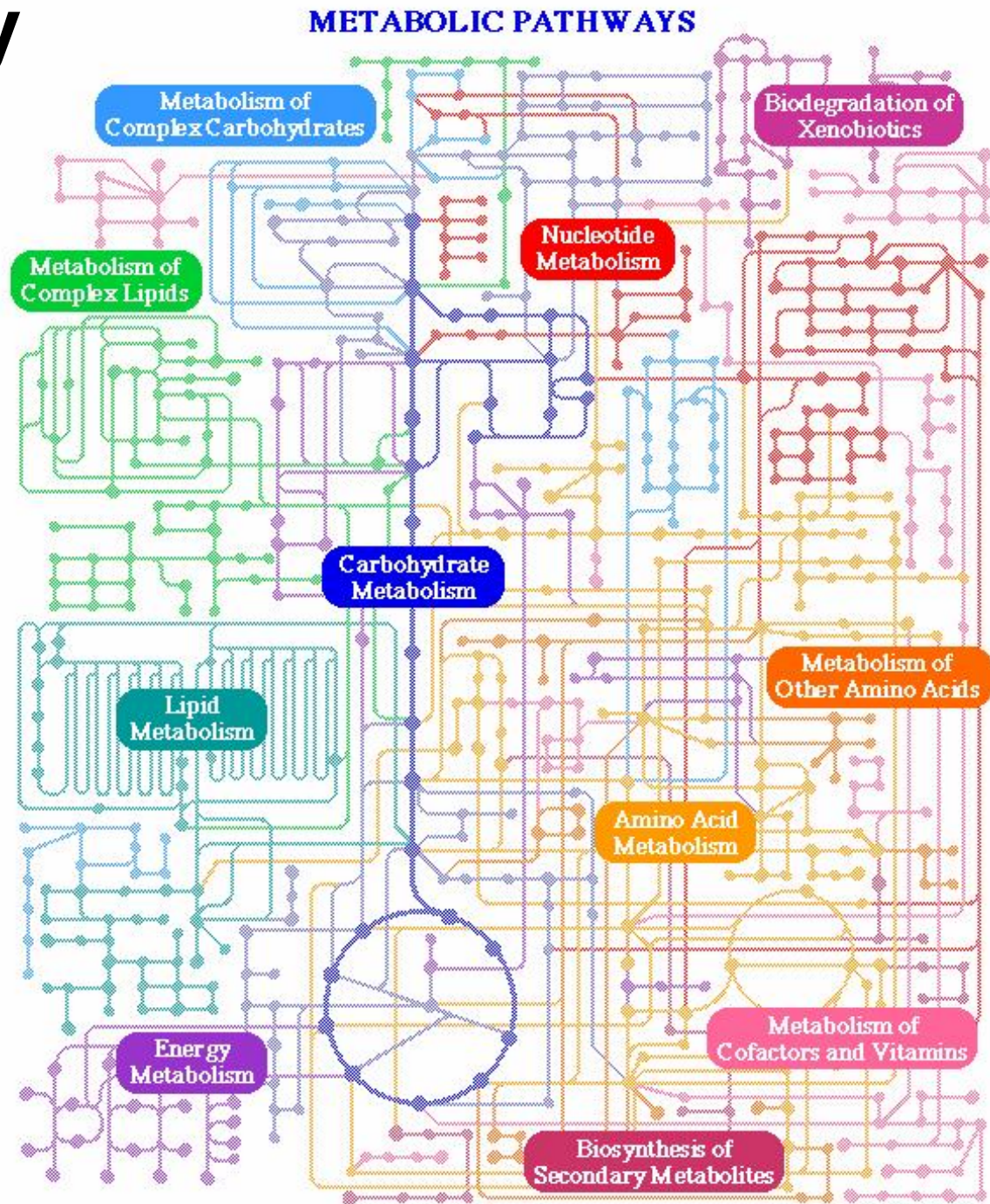


# Microarray Technology



# Systems Biology

Systems biology is a new field in biology where **organisms and biological processes** are quantitatively analysed in terms of the **components and their interaction** and described at a **system level** in a framework of **mathematical models**.



# Biotech Education



- Biology is not a watertight discipline. A multidisciplinary approach is required.
- One needs to have an understanding of tools which are put to work to arrive at the insights of the cell such as physics (protein, DNA structure) chemistry (reactions inside the cell), computers (bioinformatics), materials (diversity of biomolecules and their properties in water)

# Approach for a student

- Students should try to gain both ***theoretical*** as well as ***practical knowledge*** (do simple experiments but do them sincerely)-appreciate that experimentation is important, you develop a flare for doing things with your own hands.
- ***Strong grounding in mathematics***, physics, chemistry
- ***Design*** and ***architecture*** of living cell
- A background in ***computers*** and instrumentation will always help
- Sticking to the course curriculum is not enough
- A good dose of ***conventional hard work***, ***motivation*** and ***interest*** can reap rich dividends.

# Career Opportunities



- **Academic-Universities, Institutes of Higher Learning:**

The research funding for molecular biology and medicine is maximum of the research allotted to other disciplines-nationally also big companies like Tata's, Birla's, Reliance are investing in biotechnology sector.

# Industry

A decorative graphic consisting of six circles arranged in two rows. The top row has three circles: a solid light purple circle on the left, an empty light purple circle in the middle, and a solid light purple circle on the right. The bottom row has three circles: a solid light purple circle on the left, an empty light purple circle in the middle, and a solid light purple circle on the right.

- -Pharma,
- Process,
- Textile,
- Food processing,
- Agri-companies (transgenics for seeds, yield, stress and salt resistant crops, nutritionally enriched vegetables, edible vaccines etc).

A decorative graphic at the top of the slide consists of six circles arranged in a horizontal line. From left to right, the circles are: a solid light purple circle, an outlined light purple circle, a solid light purple circle, an outlined light purple circle, an outlined light purple circle, and a solid light purple circle.

# Hospitals

- Clinical trials
- Patient Data Base managements
- Inter-linked Medical Net-works etc.

# Services-New technologies-need someone fully qualified

- Genomics-DNA sequencing, synthesis,
- Proteomics-protein analysis
- Protein crystallization services etc.

# Technology Incubation Units

- Different concept wherein promising findings in the laboratory are incubated in a bigger and more focused way-to analyze results carefully (5 years for biotech and 2-3 years for IT products)
- Start-up companies

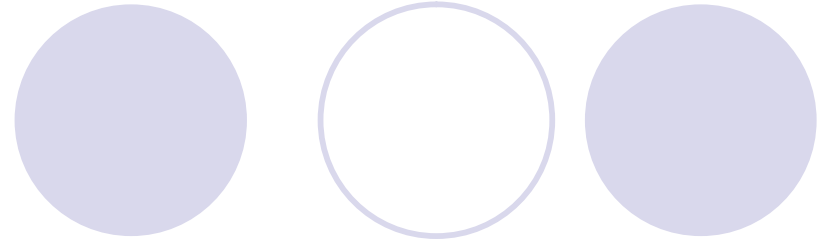
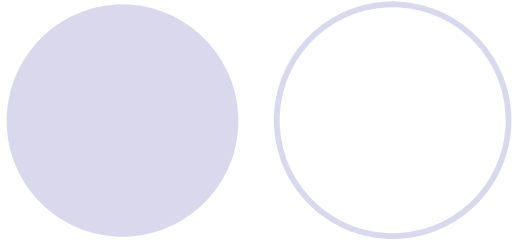
# IPR and Patents



- One cannot copy a product and make money.
- New IPR is possible by taking advantage of the application of emerging knowledge.
- Protect the findings of scientists, institutions

National Law Universities-Bangalore,Hyderabad,  
Calcutta,Bhopal, Jodhpur,ahmedabad

Delhi University Law School,Indian Law Institute.



- ***Nothing great was ever achieved without enthusiasm***

R. W. Emerson

- ***Chance favors a prepared mind***

E.B. Chain



**Thank you.**