

MSc Microbiology Sem IV MIC 403c

MICROBIAL GENOMICS &
PROTEOMICS

Lecture 1 | Introduction

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Genetics to Genes to Genomics

- **Genetics** is the study of **genes** and the way that certain traits or conditions are passed down from one generation to another
- **Genes:**
 - structural and functional unit of heredity
- **Genome:** Entire Content of genetic material
- **Genomics: Study of structure & function of genome and its effect on growth, development and heredity in an individual**

Genomics terminology

- **Gene: Greek to mean birth/create**
- **Genome First Used by Hans Winkler (1926)**
- **Coined by Tom Roderick (1986) mapping of human genome**
- **Frederick Sanger, Father of genomics- enormous contribution due to DNA sequencing technology**

How Our Understanding of Gene has evolved

- 1941. Beadle and Tatum - One Gene One Enzyme Theory

Each gene directly produces One enzyme that affects one step in metabolic pathway

1945. Beadle modified – One gene one polypeptide

Genes also code non enzyme proteins and **individual polypeptides**

1976. Walter Fiers- RNA bacteriophage MS2 genome sequenced

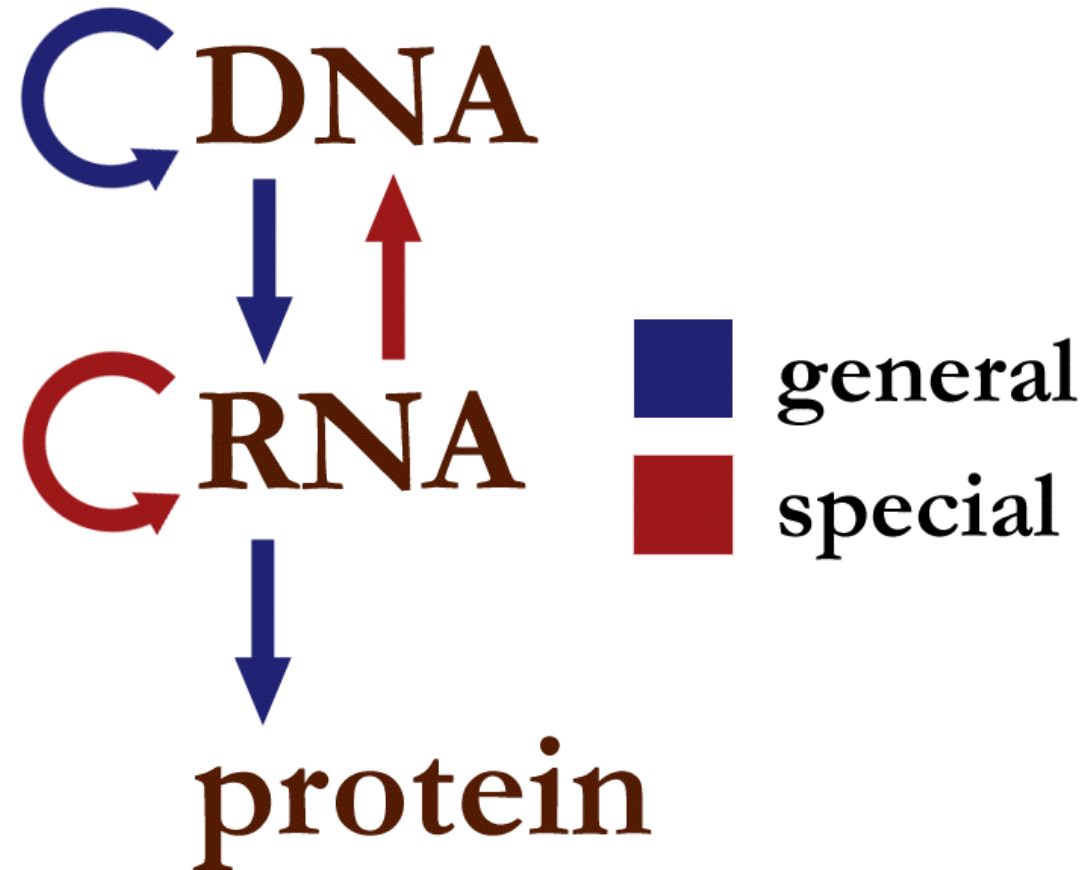
1965. Holley- tRNA in Bakers yeasts

The DNA sequence from which a functional non-coding **RNA** is transcribed is often called an **RNA gene**.

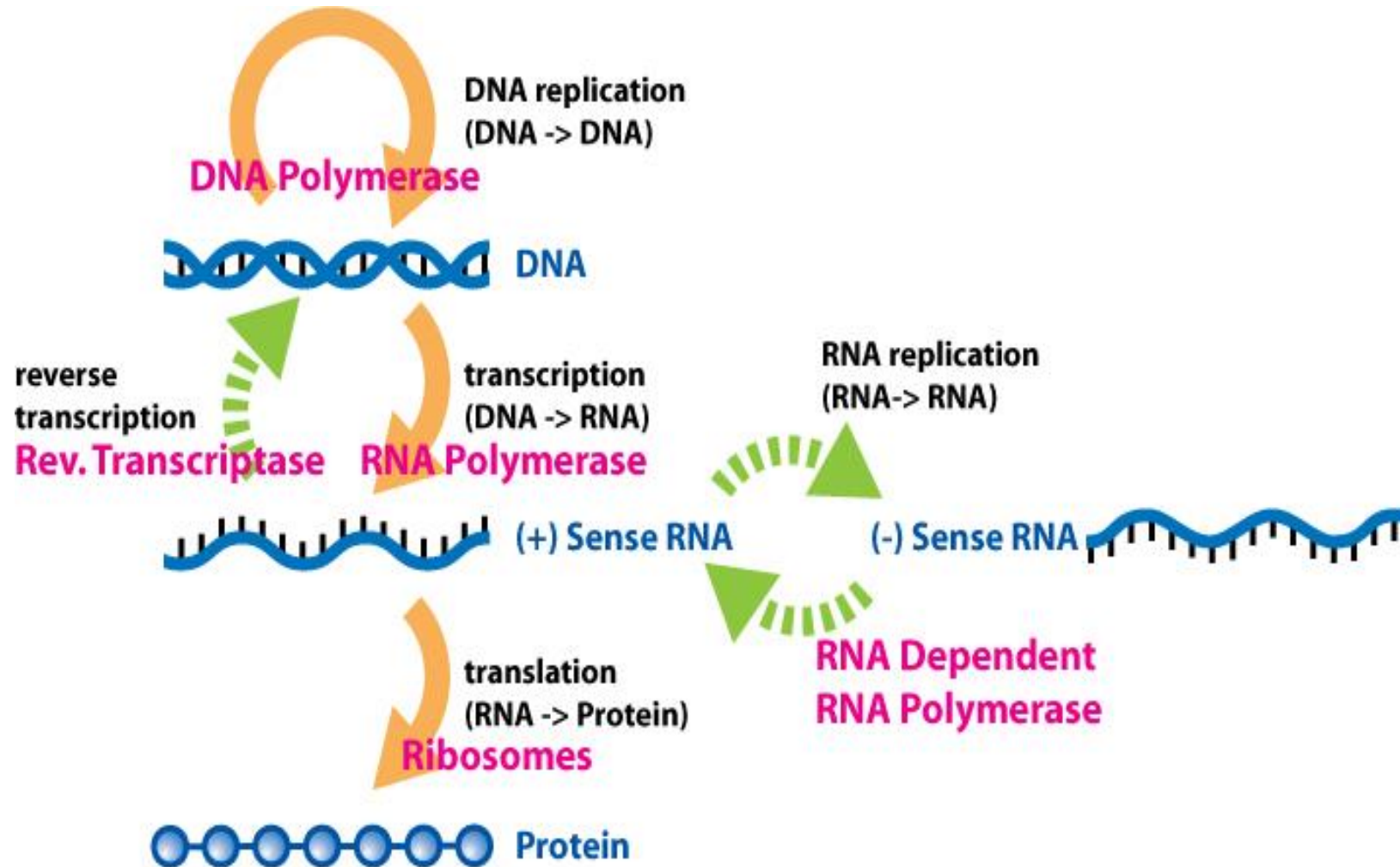
String of nucleotides (RNA/DNA) that encodes synthesis of gene product that can be RNA or protein that can be inherited

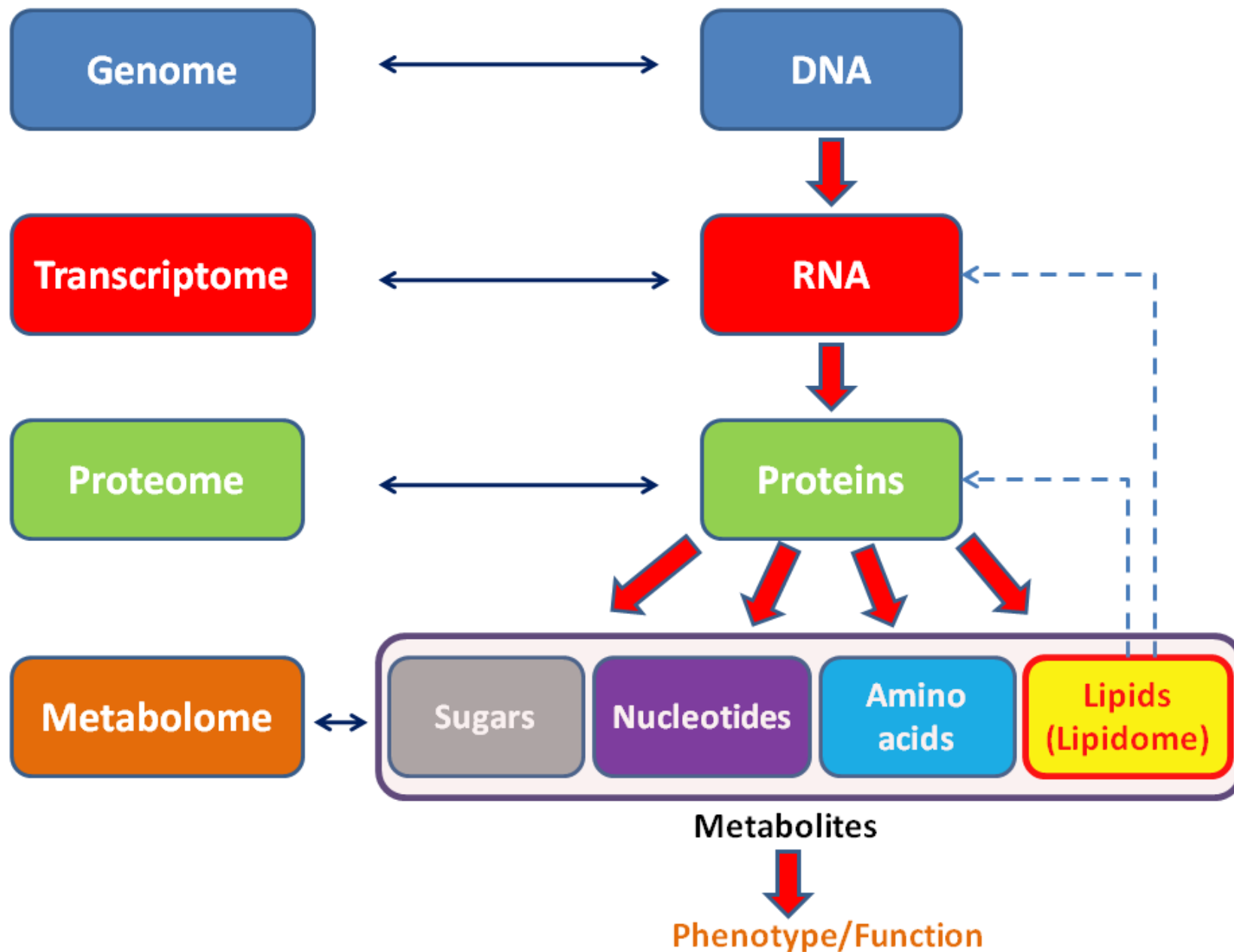
Central Dogma of Molecular Biology

Francis Crick, 1958



Genetic Flow of Information using polymers





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<https://en.wikipedia.org/w/index.php?curid=21274382>

Ome	Constant/Variable	Technology/Method
Genome	Constant	DNA/RNA Sequence and Structure
Transcriptome	Variable	Comparison of structure and function of RNA between samples or same sample under variable conditions
Proteome	Variable	Comparison of structure and function of protein between samples or same sample under variable conditions

Definitions

- **OMICS:** Branch of science explore collective role, relationship and functions of various components
- **Gene:** String of nucleotides (RNA/DNA) that encodes synthesis of gene product that can be RNA or protein
- **Genome:** Entire genetic component of an organism- nuclear/chromosomal genome only
 - **Prokaryote:** Chromosomal genome and Extrachromosomal Genome
 - **Eukaryote:** Nuclear genome and Mitochondrial(mtDNA)/ Chloroplast (cpDNA) genome
- **Genomics:** Study of genome
- **Metagenome:** Complete mixture of genomes present on a particular habitat
- **Metagenomics:** Study of mixture of genomes present on a particular habitat

- **Transcriptome: Entire content RNA transcripts (*coding and non coding) of a cell (at a given time)**
- **Transcriptomics: Study of entire RNA transcripts of a cell using variety of techniques**
- **Proteome: Entire collection of functional protein synthesized in a cell**
- **Proteomics: Variety of techniques used to study proteome**
- **Metabolome: Entire collection of metabolites in a cell**
- **Metabolomics: Study of the all metabolome**
- **Interactome: Entire network of interactions between different pathways**

Entire Collection

- **Glycome** : entire complement of sugars in an organism
- Glycomics: Study of entire glycobiology
- **Lipidome**: entire complement of lipids in an organism
- Lipidomics: large scale study of cellular lipids (pathways and networks) in biological systems

Advances leading to the development of Genomics, Transcriptomics and Proteomics

- *High throughput technologies*- generation of genome/transcriptome/proteome data OR information
- *Bioinformatics*: Branch of science dealing with the application of information technology for the management and analyses of biological data
 - Large data generated from genome/RNA and protein sequencing projects
 - Databases for organizing and retrieval of data
- *Computational Biology*: Branch of biology dealing with developing mathematical and computational approaches to study biological problems
 - Analysis of biological data
- *Networking and Internet advances*: Speed and data handling capacity

