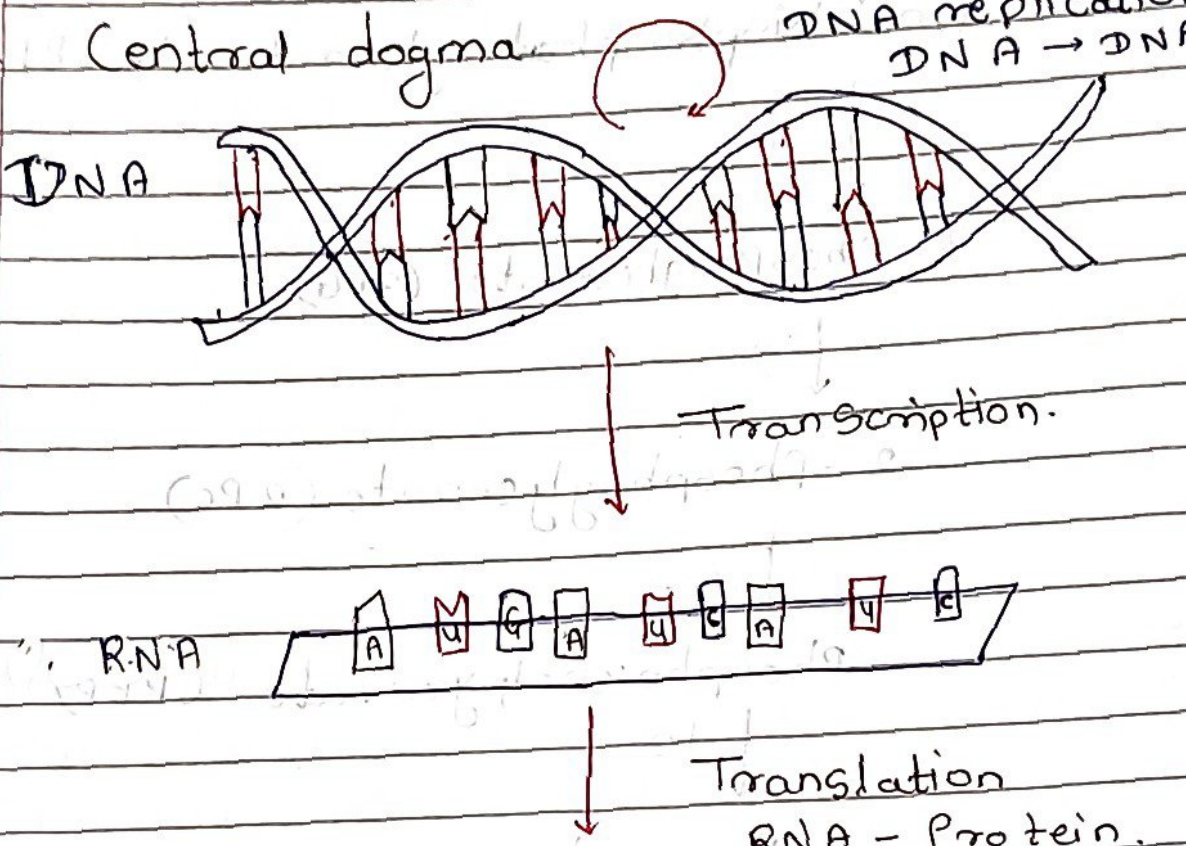
Day
Tuseday

Date 5-9-23
Page

* Central dogma



① Transcripstion:

The first step during protein synthesis when the DNA in a gene is copied to produce an RNA transcript called messenger RNA (mRNA)

① Difference between photosystem 1 & 2.

1	2
• Located in outer wall of thylakoid membrane	• Located at inner surface of thylakoid membrane
• Reaction centre - P700	• Reaction center. P-680.
• Pigment absorbs longer wavelength	• absorbs shorter wavelength < 680.
• Involved in cyclic photophosphorelation.	• Involved in both cyclic and non-cyclic.
• Main is NADPH Synthesis	• ATP Synthesis.

② What is Faster, Transcription or Translation?

Transcription, the synthesis of mRNA from DNA, and translation, the synthesis of protein from mRNA, are the main pillars of the central dogma of molecular biology.

Transcription of RNA in E.coli of both mRNA and the stable rRNA and tRNA, is carried out by ≈ 1000 - 10,000 RNA polymerase molecules proceeding at a maximal speed of about 40-80 nt/sec.

Translation of proteins in E. coli is carried out by = 10,000 - 1000,00 ribosomes and proceeds at a maximal speed of about 20 aa.

⊙ How Fast do RNAs and proteins degrade?

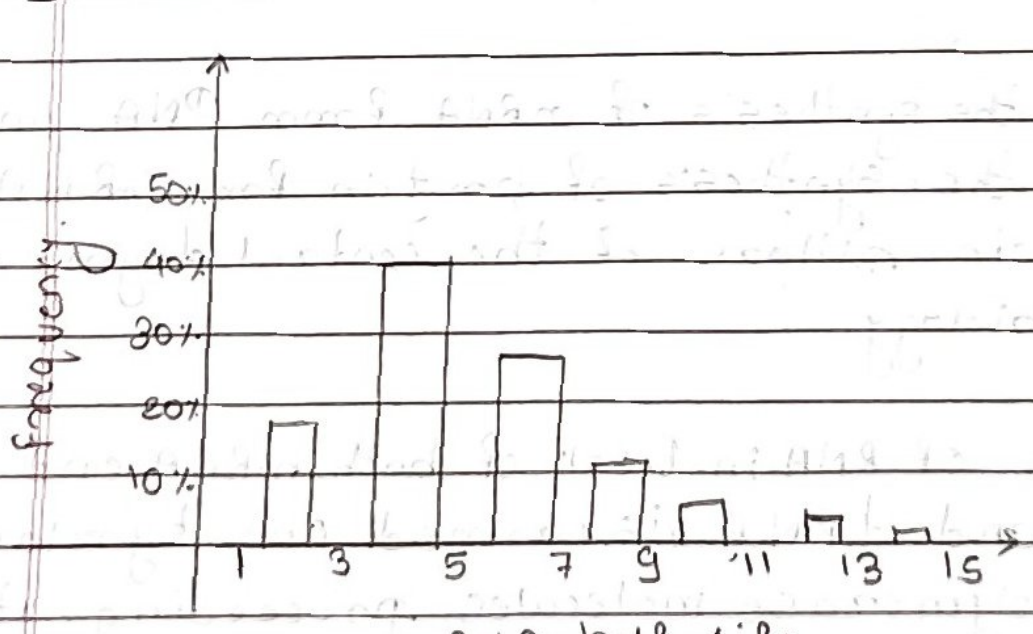
Degradation is another key process in the lives of macromolecules of the cell and is itself tightly controlled. Indeed, in the simplest model of mRNA Production, the dynamics of the average level of mRNA is given by,

$$\frac{d\bar{m}}{dt} = r - \gamma \bar{m}$$

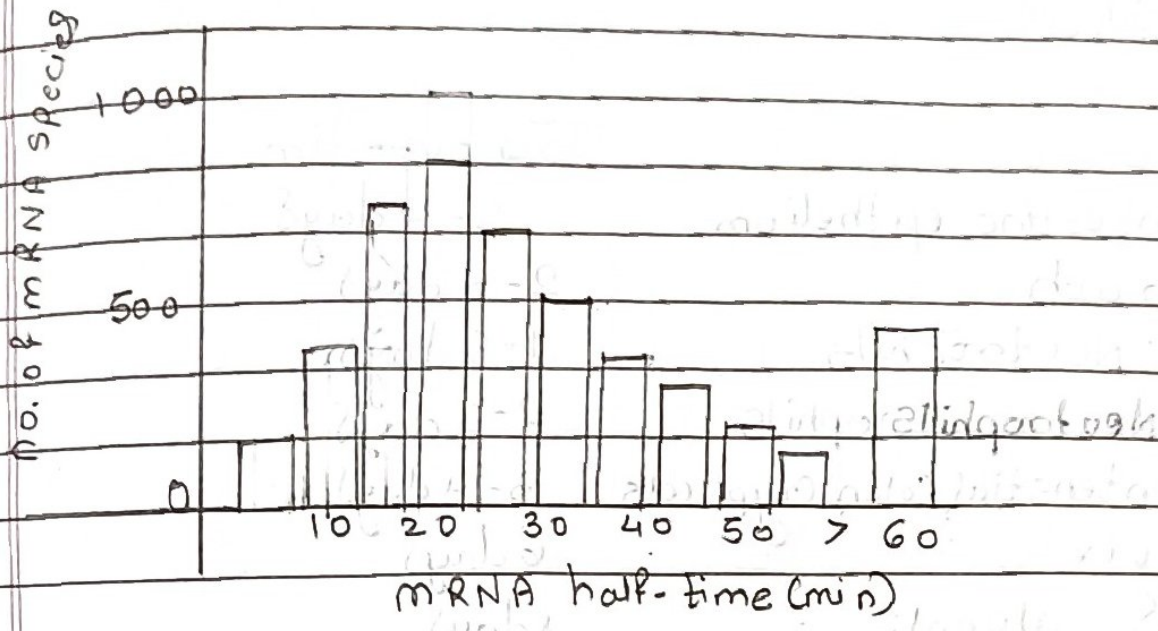
Where r is the rate of mRNA production and γ is the rate constant dictating mRNA decay. The Steady-State value of the mRNA is given by,

$$\bar{m} = \frac{r}{\gamma}.$$

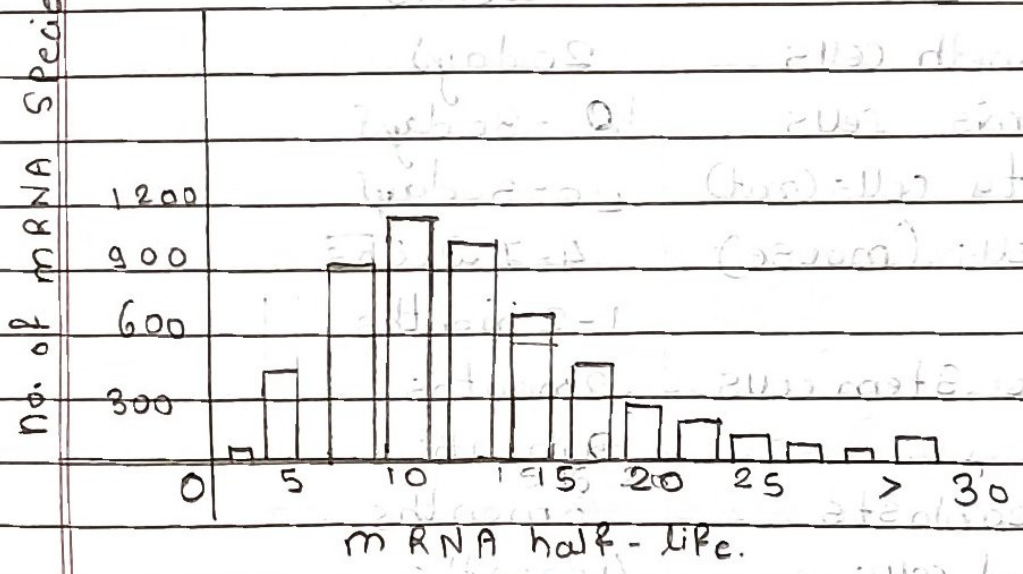
A E. Coli



B] S. cerevisiae.



C] H. Sapiens.



The lifetime of mRNA molecules is usually short in comparison with the fundamental time scale of cell biology defined by the time between cell divisions. For E coli, the majority of mRNA molecules have lifetimes b/n 3 & 8 minutes.

⊙ How quickly do different cells in the body Replace themselves?

Cell type	Turnover time
Small intestine epithelium	2-4 days
Stomach	2-9 days
blood Neutrophils	1-5 days.
White blood cells Eosinophils	2-5 days
gastrointenstial Colon Crypt cells	3-4 days
Cervix	6 days
lungs alveoli	8 days
tounge taste buds (rat)	10 days
Platelets	10 days
bone osteoclasts	2 weeks
instestine Paneth cells	20 days
Skin epidermis cells	10-30 days
Pancreas beta cells (rat)	20-50 days
blood B cells (mouse)	4-7 weeks
trachea	1-2 months
hematopoietic Stem cells	2 months
Sperm	2 months
bone osteoblasts	3 months
red blood cells	4 months.
liver hepatocyte cells	0.5-1 year
Fat cell	8 years
Cardiomyocytes	0.5-1% per year
lens cell	Life time
Central nervous system	Life time
Skeleton	10% per year
Oocytes	Life time.

* Nuelic acid → monomer → Nucleotides.

Q How can the replacement rates of cells in various tissues in our body be measured?

The level of ^{14}C in genomic DNA closely parallels atmospheric ^{14}C levels and can be used to establish the time point when the DNA was synthesized and cells were born.

Fat cells replace at a rate of 8 ± 6% per year. This results in the replacement of half of the body's adipocytes in 8 ± 5 years.

Replacement of heart muscle cells occurs albeit at a slow rate. estimates vary from 0.5% per year to as high as 30% per year depending on age and gender.

1] The Cerebral Cortex - your entire life.
The nerve cells that make you, many of your thoughts and memories are found here.

2] Tooth Enamel - your entire life (almost)
The protective enamel on your teeth is formed once, at various points prior to the age of 12 and never again.

3] Hippocampus - 20 to 30 years.
Together with an area of the brain called the Striatum, this is the only part of the human brain where the formation of new nerve cells has been detected. Around 1400 new nerve cells are born here every day & these help to create new memories.

4 Surface of the guts - 5 days.
The epithelial cells that form the surface of the guts are, like skin cells, part of a vulnerable group and have short lives.

5 Fat cells - 10 years.
We gain about ten per cent new fat cells each year and about the same quantity die. When we gain weight, our fat cells have been given lots of food and have become fat.

⊙ Alterations in cell turnover are key feature in several diseases.

- decreased erythrocyte production - aplastic anemia
- increased keratinocyte trunover - psoriasis.
- decreased neurogensis - depression
- Impaired production of cardiomyocytes - heart failure

Inspired by 14C-dating in archeology Spalding et.al 2005 developed to restrospectively determine the age of cells without the need for delivering any chemical to the individual prior to the analysis

14C levels on earth have remined relatively constant over long time periods, and the radioactive decay of the isotope is used to retrospectively date biological material in ~~der~~ archeology. The resolution in morden time is poor due to a half-life of 5730 years.

14C in genomic DNA reflects the Age of cells.

Most molecules in a cell are in constant flux, with the unique exception of genomic DNA, which is not exchanged after a cell has gone through its last division. The level of 14C integrated into genomic DNA should thus reflects the level in the atmosphere.

Determination of 14C levels in genomic DNA could be used to restrospectively establish the birth date of cells in the human body.