



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

GENES

Dr. Amrutha Gopan
Assistant Professor
School of Fisheries
Centurion University of Technology and Management
Odisha

Centurion University of Technology and Management



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities.*

GENES

- A gene represents a unit of specific molecular information and corresponds to a discrete segment of DNA.
- The information is given by the sequence of the different bases (A,C,G,T) found in that segment.



Centurion
UNIVERSITY

Shaping Lives
Empowering Communities

Evidence that genes are made of DNA (or sometimes RNA)

➤ Transformation in Bacteria. - Frederick Griffith

- experiments on transformation in the bacterium *Pneumococcus*
- laid the foundation for the identification of DNA as the genetic material



Centurion
UNIVERSITY

Shaping lives...
Empowering communities...

Contd.....

- DNA: The transforming material- Oswald Avery, Colin MacLeod, and Maclyn McCarty
- showed the transforming substance to be DNA in virulent cells of *Streptococcus pneumoniae*.



Centurion
UNIVERSITY

*Shaping Lives
Empowering Communities*

DNA consists

- nitrogenous bases,
- phosphoric acid, and
- the sugar deoxyribose.



Centurion
UNIVERSITY

Shaping Lives
Empowering Communities.

Four bases in nucleic acids

- adenine (A),
- cytosine (C),
- guanine (G) and
- thymine (T).
- RNA contains the same bases, except that Uracil (U) replaces thymine



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Purines & pyrimidines

➤ Adenine and Guanine are purines

➤ two ringed structures

➤ Cytosine and thymine are pyrimidines

➤ single ringed structures



Centurion
UNIVERSITY

Shaping Lives.
Empowering Communities.

Nucleosides and nucleotides

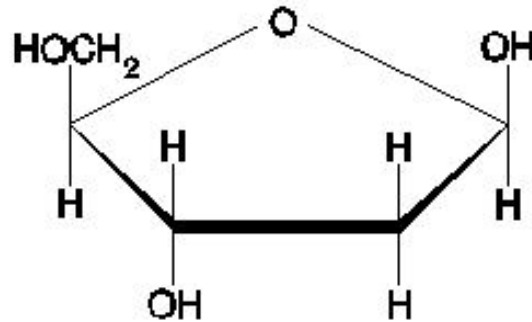
- The bases and sugars in RNA and DNA are joined together into units called *Nucleosides*
- nucleosides with a phosphate group attached through a phosphodiester bond called *nucleotides*
- Nucleotides are the subunits of DNA and RNA



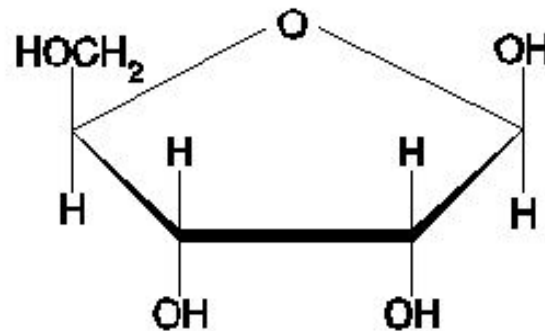
Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Structure of Deoxyribose and ribose sugar



Deoxyribose



Ribose



Centurion
UNIVERSITY

Shaping Lives,
Empowering Communities.

X-ray diffraction

➤ Maurice Wilkins and Rosalind Franklin

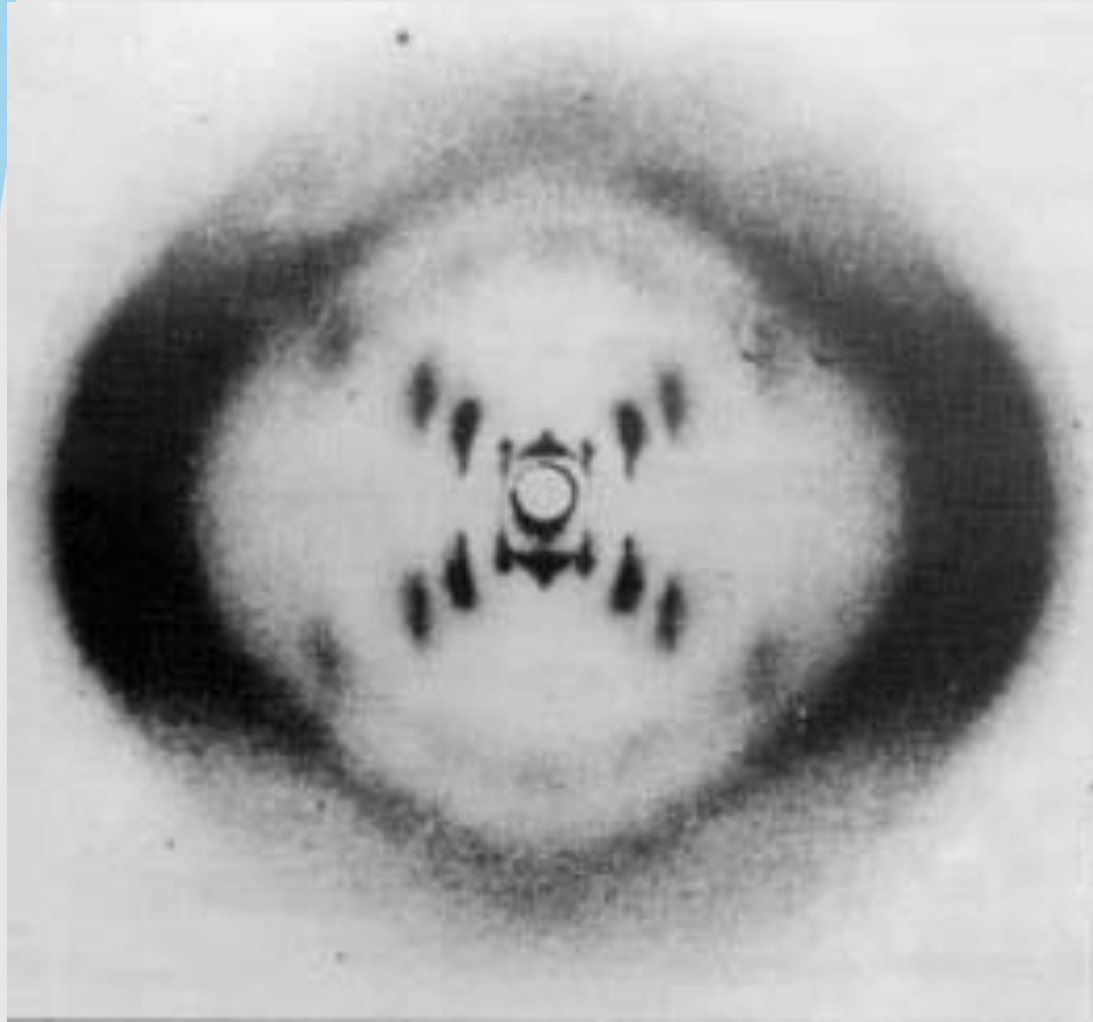
- used X-ray diffraction to analyse the three-dimensional structure of DNA which revealed the helical nature of the structure and indicated some of the key dimensions within the helix



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

X-ray diffraction of DNA





Centurion
UNIVERSITY

*Shaping Lives
Empowering Communities*

Base pair analysis - Erwin Chargaff

the amount of adenine and thymine were always equal, as were the amount of guanine and cytosine

- Adenine = Thymine
- Guanine = Cytosine
- base-pairing, provided a valuable confirmation of Watson and Crick's model.

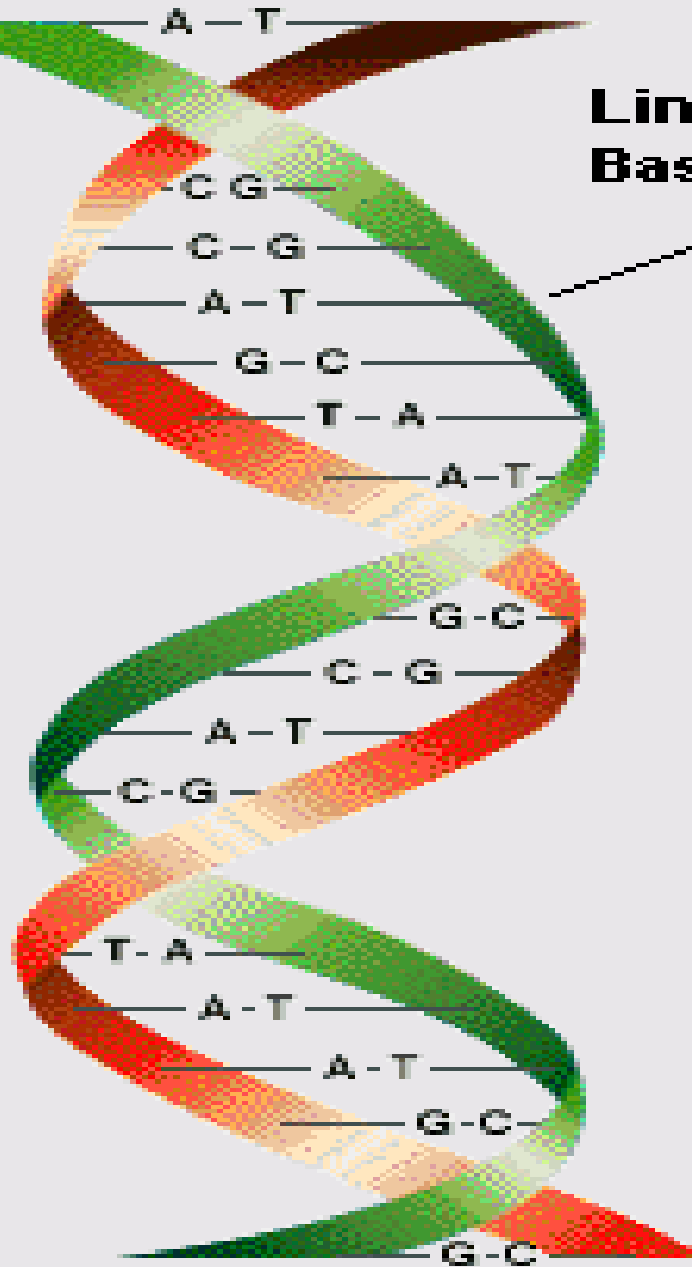


Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Spiral A

Spiral B



Linking Nitrogen Bases

A = adenine
T = thymine
G = guanine
C = cytosine



Centurion
UNIVERSITY

Shaping lives...
Empowering communities.

The Double helix

- Watson and Crick found that the best model that satisfied all the X-ray data
- a double helix with the sugar phosphate chain on the outside and the bases on the inside.
- The two chains run in an anti parallel
- one chain having a $5' \rightarrow 3'$ orientation
- the other having a $3' \rightarrow 5'$ orientation.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Features of watson and crick model

- Two strands of double helix are antiparallel
- Double helix comprises of two complementary polynucleotide chains
- Phosphate groups give the molecule a negative charge
- The nitrogenous bases lie almost perpendicular to the long axis of the molecule



Centurion
UNIVERSITY

Shaping Lives,
Empowering Communities.

Contd.....

- The width or diameter of the double helix is 2 nm
- The nitrogenous bases of two anti-parallel polynucleotide strands are linked through hydrogen bonds
- Two hydrogen bonds between A and T, and t
- Three hydrogen bonds between G and C



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

MITOCHONDRIAL DNA

- In mammals 99.99% of mitochondrial DNA (mtDNA) is inherited from the mother
- as sperm carry mitochondria in their tail and have only ~ 100 mitochondria compared to 100 000 in an egg
- liver cells have ~1000 mitochondria



Centurion
UNIVERSITY

Shaping Lives
Empowering Communities

RNA GENES

- some viruses, including several phages, plant and animal viruses (e.g., HIV, the AIDS virus), have RNA genes.
- viral RNA genes are double-stranded but usually they are single - stranded.



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

FORMS OF DNA

- B-DNA (Right-handed DNA)
- A-DNA (Right-handed DNA)



Centurion
UNIVERSITY

*Shaping Lives.
Empowering Communities...*

Genome

★ The genome is a store of biological information but on its own it is unable to release that information to the cell.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

GENE EXPRESSION

- Is the molecular mechanism by which a gene produces specific phenotype
- Which controls a specific metabolic activity



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

The genome, transcriptome and proteome

Genome

↓ Transcription

Transcriptome

(RNA copies of the active protein-coding genes)

↓ Translation

Proteome

(The cell's repertoire of proteins)



Centurion
UNIVERSITY

Shaping Lives
Empowering Communities...

GENE

- A gene is a unit of information which is held as a code in a discrete segment of DNA.
- This code specifies the amino acid sequence of a protein.
- Exons- The coding parts of a gene sequence.
- Introns-The non coding parts of a gene sequence



Centurion
UNIVERSITY
Shaping Lives...
Empowering Communities

Activities of genes

- A gene can be replicated - genetic information can be passed from generation to generation unchanged.
- The sequences of bases in the RNA depends directly on the sequences of bases in the gene.
- A gene can accept occasional changes, or mutations.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Thank you