

# *The Discovery of Genetic Material and Its Location*

- Fredrich Miescher first investigated a substance called nuclein – now referred to as DNA
- Hammerling's experiments of the 1930s with *Acetabularia* – a one-celled green algae – helped confirm that the genetic material that gave rise to a new individual was located in the nucleus of a cell – Figure 2, p. 207 illustrates his results
- T.H. Morgan's group showed that genes are located on structures called chromosomes – structures made of DNA and protein
- the argument as to which substance, DNA or proteins, was considered as the "genetic material" that was passed onto offspring continued up until the 1940s
- until then the case for proteins seemed stronger, especially since biochemists had identified them as a class of macromolecules with great heterogeneity and specificity of function, essential requirements for the heredity material

## *Evidence That DNA Codes for Changes in Phenotype – The Transforming Principle*

- in 1928, Frederick Griffith studied two strains of the bacterium *Streptococcus pneumoniae* in mammals – a disease-causing strain, and a harmless strain
- he found that when he killed the pathogenic strain with heat and mixed the cellular remains with living harmless strains, some of the living cells were converted to the pathogenic form
- the offspring of the transformed bacteria inherited the new trait of pathogenicity
- the exact cause of this transformation was not known until Oswald Avery and his colleagues, in 1944, added purified chemicals, not cellular remains, from heat-killed pathogenic bacteria, to harmless strains
- he found that it was only the DNA of the pathogenic strain that caused the harmless strain to develop disease-causing phenotypes
- even though the results were significant and conclusive, they were not universally accepted by the scientific community
- a lot of scientists still believed that proteins were the cause of such transformations, not DNA
- many had a difficult time accepting the fact that complex organisms, like us, would possess the same genetic mechanisms as bacteria
- additional evidence for DNA as the genetic material came from studies of a virus that infects bacteria
- a virus is a simple organism that consists of DNA, surrounded by a protein coat
- in order for a virus to reproduce, it must infect a cell and take over the cell's metabolic machinery
- viruses that infect bacteria are called **bacteriophages** or simply **phages** (see Figure 3, p. 208)
- in 1952 Hershey and Chase discovered that DNA is the genetic material of a phage known as T2
- a T2 phage can quickly turn the bacteria cell *E. coli* into a T2-producing factory that releases phages when the bacteria cell ruptures
- Figure 4, p. 209 illustrates Hershey and Chase's experiment

- since sulphur is only found in proteins and phosphorous is only found in DNA, Hershey and Chase labeled the protein coat and DNA of T2 phages accordingly with S-35 and P-32
- both labeled batches were allowed to infect the non-radioactive/unlabeled host bacterial cell
- after centrifugation, Hershey and Chase found no evidence of protein-labeled substances in the bacteria, however they did find DNA-labeled substances in the *E. coli*
- if the virus was aloud to run its course, eventually the *E. coli* would rupture and produce phages that contained radioactive phosphorous – not sulphur
- DNA of the virus is injected into the host cell, while most of the proteins remain outside
- injected DNA molecules cause the cells to produce new viral DNA and proteins
- nucleic acids, rather than proteins, are the hereditary material

### *Additional Evidence That DNA Is the Genetic Material of Cells*

- in 1947, Chargaff reported that DNA composition varies from one species to another – the amounts of the nitrogenous bases are not all equal but are present in a characteristic ratio
- this evidence of biodiversity between different species made DNA a more credible candidate for the genetic material
- Chargaff found a regularity in the ratios of nucleotide bases – the number of adenine bases equaled the number of thymine bases, the number of guanines equaled the number of cytosines
- these particular findings were unexplained until the discovery of the double helix model by Watson and Crick

*Homework:* 1-3, p. 209