

2023 Bi H2 Q5

Section: DNA and the Genome

Topic: Structure of DNA

Question Summary

You are asked to write notes on the organisation and location of DNA in prokaryotic and eukaryotic cells. The question compares how genetic material is arranged and where it is found in each cell type.

Worked Solution

Prokaryotic Cells

- DNA is found free in the cytoplasm, not within a nucleus.
- It exists as a single circular chromosome.
- There are also small circular plasmids, which contain a few genes that can be transferred between cells.
- The DNA is not associated with proteins (i.e., not wound around histones).
- Replication and gene expression occur directly in the cytoplasm.

Eukaryotic Cells

- DNA is found within a membrane-bound nucleus.
- It is organised into linear chromosomes made of DNA tightly coiled around histone proteins.
- Mitochondria and chloroplasts also contain small circular

chromosomes resembling those of prokaryotes.

- The nuclear DNA controls most cell activities, while organelle DNA encodes some proteins for respiration or photosynthesis.
- Eukaryotic DNA therefore shows both linear nuclear and circular organelle forms.

Final Answer

■ Prokaryotes: circular, free, no histones, cytoplasmic plasmids

■ Eukaryotes: linear chromosomes with histones in nucleus;
circular DNA in mitochondria and chloroplasts

Revision Tips

- Histones: proteins that help coil and stabilise eukaryotic DNA.
- Plasmids: small circular DNA loops carrying extra genes (e.g. antibiotic resistance).
- Endosymbiont theory: organelle DNA supports the idea that mitochondria and chloroplasts evolved from free-living prokaryotes.
- Compare keywords:
 - Prokaryote → circular, no histones, cytoplasm
 - Eukaryote → linear, histones, nucleus + organelles