Prokaryotic DNA

Organization of DNA in prokaryotes

- tightly coiled ("supercoiled")
- ATP required
Eukaryotic DNA Organization

- Histones
- Nucleosomes
- Chromatin fiber
- Euchromatin & heterochromatin
- Condensation, duplication

Hydrogen bond

- Remember that the bases pair in a complementary fashion A=T or A=U (RNA), G=C
- Hydrogen bonds hold bases together
- Three for G-C, two for A-T

DNA Replication

- Requires DNA polymerase and helicase
- Semi-conservative
**DNA REPLICATION**

**“Other” DNA: Plasmids**

**(Microbial) Gene Expression**
Transcription

Requires RNA Polymerase

gene

rRNA

mRNA

tRNA

xcr

How does RNAP know where to begin transcription?

promoters

-35

TGGACA

-10

TATAAT

AACTGT

ATATTA

σ

β

α

β

α
**RNA PROCESSING**

- Adding a cap and tail
- Removing introns
- Splicing exons together
- Final product is mRNA

**Translation**

**mRNA**

- carries coding information for amino acids = codons
  - 3 adjacent nucleotide bases
  - e.g. AAA, AGU, etc.
### Genetic Code

**Stop Codons**

- a.k.a. *nonsense* codons
  - **UAG** - amber
  - **UGA** - opal
  - **UAA** - ochre

### Transfer RNA (tRNA)

**Anticodon**

**Amino acid attachment site**

**Hydrogen bond**

**RNA polynucleotide chain**
Pro- & Eukaryotic Ribosomes Compared

5S rRNA
23S rRNA + 33 polypeptides
Prokaryotic 70S ribosome

16S rRNA + 21 polypeptides
35 subunit

5S rRNA
23S rRNA + 34 polypeptides
Eukaryotic 80S ribosome

16S rRNA + > 21 polypeptides
60S subunit

5S rRNA
25S rRNA + 34 polypeptides

40S subunit

Pro- & Eukaryotic Ribosomes Compared

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Protein synthesis
Polypeptide
Amino acid
P site
Anticodon
A site
Codons
Codon recognition
Peptide bond formation
New peptide bond
mRNA movement
mRNA
Elongation
Translocation

Polyribosomes

Bauman (2003) Microbiology Fig. 7.13
Prokaryotic Gene Organization: Operons

Phenotype vs. Genotype

Wild-type vs. mutant
Types of mutations

- **Wild-type DNA** (wild-type phenotype)
- **Mutant DNA** (mutant phenotype)
  - **Forward mutation**
  - **Backward mutation**
  - **Suppressor mutation**

**Mechanisms of Mutations**

- Can be divided into two general categories
  - **Base Substitutions**
  - **Base Deletions/Insertions**
- Can result in changes in the amino acids in proteins

**Mutations**

- **DNA**
- **mRNA**
- **Amino acid**

- **Wild type**
  - **A U**
  - Phenylalanine

- **Silent point mutation**
  - **A U**
  - Phenylalanine

- **Suppressor mutation**
  - **A U**
  - Phenylalanine

- **Backward mutation**
  - **A U**
  - Phenylalanine

- **Forward mutation**
  - **A U**
  - Phenylalanine

- **Suppressor mutation**
  - **A U**
  - Phenylalanine
Mutations

DNA mRNA amino acid

wild type

phenylalanine

missense point mutation

leucine

Mutations

DNA mRNA amino acid

wild type

phenylalanine

nonsense point mutation

STOP

Nucleotide Substitution: Spontaneous Error

mRNA

Protein Met Lys Phe Gly Ala

Base substitution

Met Lys Phe Ser Ala
Nucleotide Substitution: Base Analogs

Nucleotide Substitution: Thymine Dimers

Nucleotide Substitution: T-T Dimer Repair
Frameshift Mutations

- Usually have disastrous effects
- Change the reading frame of the genetic message

Cell cycle

- regulatory proteins
  - E.g. Cyclins

Carcinogens

- mutagens
Ames test

- Minimal - histidine plate
- Disk with test chemical
- Incubate O/N at 37°C
- Revertant colonies (mutants)
- Positive result
- Negative result

Unique Features of Bacterial Genetics

- Single genome per cell
- Fast growth rates
- Enormous numbers of offspring
- Easily sequenced
- Unique methods of recombination

Bacterial Recombination

- Vertical vs. Horizontal Gene Transfer
  - Transformation
  - Transduction
  - Conjugation
  - Transposons
Transposons

- Transposable element
- Copying and insertion
- Copy of transposable element
- Gene F interrupted and no longer functional
- Transposon
- Transposable element
- Other genes
- Transposable element

Palindromes

- RACE CAR