A. GENE EXPRESSION

General Points For 'Control Of Gene Expression' Essays

- **Gene expression** involves the production of specific **mRNA** (through transcription)
- **mRNA** conveys information from **DNA** to the **ribosomes** to produce a **polypeptide** (through translation)
- **Most** genes are **switched off** at any one time.
- **Some** genes are only **expressed** at **certain times**.
- **Some** genes are **only expressed** in **certain cells/tissues (= differentiation)**
- **Hormones** can affect **gene expression** (e.g. **auxin**)

B. INTRONS AND EXONS

Introns are **DNA base sequences** that do **not code** for **proteins**

Exons are **DNA base sequences** that **code** for **proteins**

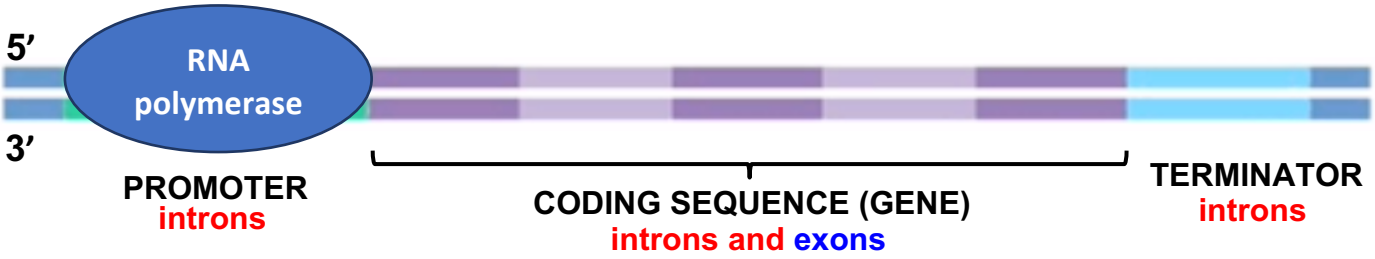
DNA base sequences that **do not code** for **proteins** have **four** main functions:

1. **Introns** – involved in **processing mRNA**
2. **Coding for tRNA and rRNA** – these are involved in **translation**
3. **Controlling gene expression/transcription** – **binding sites** for **proteins** that can **allow** or **prevent transcription**.
4. **Telomeres** – **repetitive base sequences** at the **ends** of **chromosomes**, which **prevent parts of genes here from being lost** each time the **DNA is replicated**.

Gene expression can also be **controlled** by **post-transcriptional modification/splicing** of **pre-mRNA** to form **mature mRNA***

* see earlier notes on how this increases the different types of antibody that can be produced

C. TRANSCRIPTION FACTORS & REPRESSOR PROTEINS

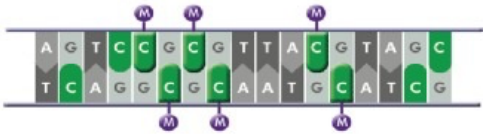


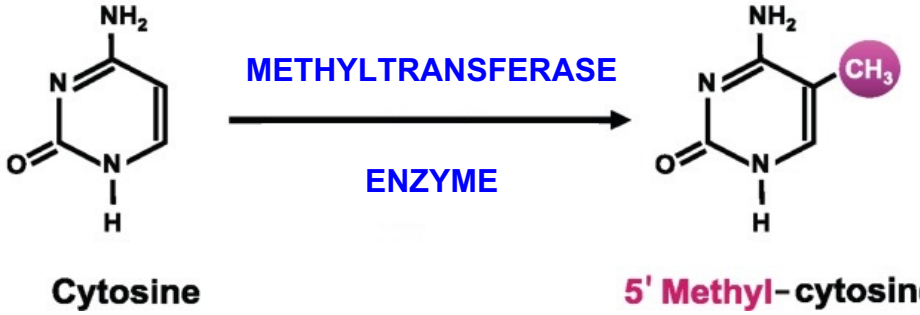
- **Transcription factors** are proteins that can attach to the **promoter** to make it **easier** or **more difficult** for **RNA polymerase** to **bind**. There are two types:

  - **Activator proteins** attach to the **promoter**, making it **easier** for **RNA polymerase** to attach and **start (increase) transcription**.

  - **Repressor proteins** attach to the **promoter**, **preventing** **RNA polymerase** from attaching so they **prevent (decrease) transcription**.

D. DNA METHYLATION & DEMETHYLATION





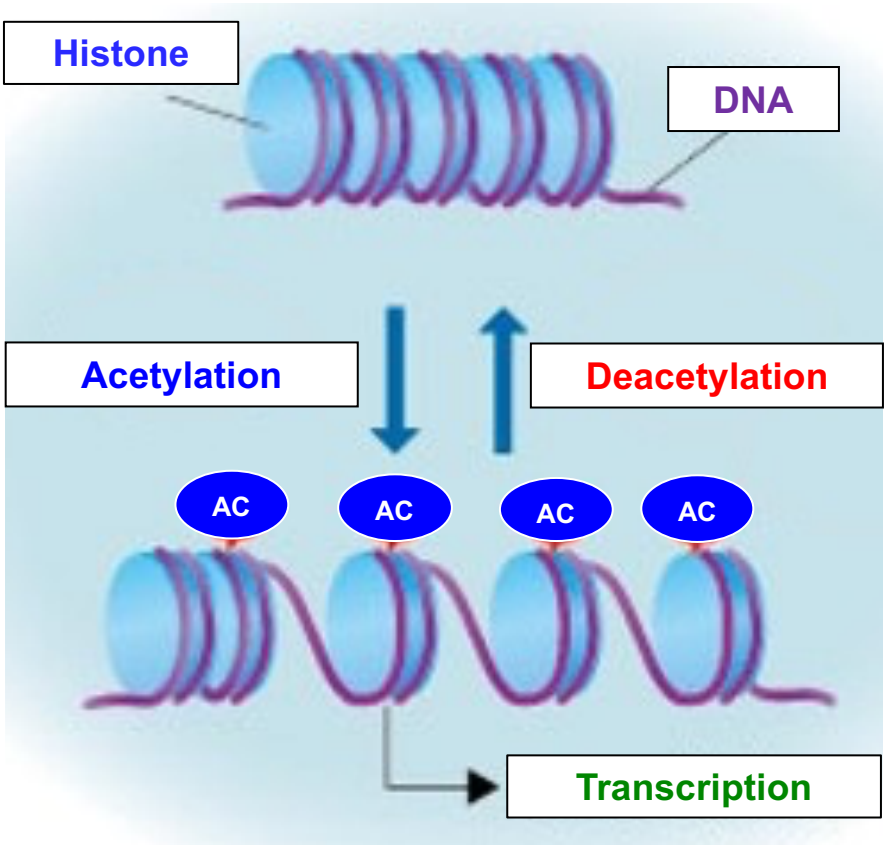
- **Attaching methyl (CH_3)** groups to the base **cytosine** **blocks RNA polymerase** when it reaches it.

- Methyl-cytosine **cannot be transcribed** so the **methylated gene** is **silenced**.

- This can only happen if there is a **guanine** (G) on the **3'** side of the **cytosine** (C).

- Methyl-cytosine can also be **demethylated** to **allow transcription** to happen again.

E. DNA ACETYLATION & DEACETYLATION



ACETYLATION OF HISTONES

- **Attaching acetyl** (AC) groups to **histone** proteins **uncoils** the DNA
- This **allows RNA polymerase** to **bind** to the **promoter** and **start transcription**

DEACETYLATION OF HISTONES

- **Detaching acetyl** (AC) groups from **histone** proteins **coils** the DNA
- This **stops RNA polymerase** from **binding** to the **promoter**, **preventing transcription**

F. EPIGENETICS

- **Heritable** (inherited) **changes** in **gene function**
- **Without changes** to the **base sequence** of **DNA**

This is the studying the **effects** of **methylation patterns** in **DNA**.

It is about studying the **effect** of **switching specific genes off** or **on**.

It is **not** about **changing** the **DNA base sequence**.

Four things that we know

1. **Methylation patterns** are decided during **embryonic development**.
2. The **% of methylated C-G** sites in our DNA reaches a **maximum** at **birth** and then **decreases** with **age**.
3. **Cells** in the **same tissue**, with the **same role**, inherit the **same methylation pattern** by **mitosis**. This means that the **same genes** are **switched off**.
4. As we get **older**, **environmental factors** have a **greater** effect on **methylation patterns**.

Identical Twins

- At **birth**, they have **similar patterns** of **methylation**.
- However, **differences build up** during their **lives** - probably due to **environmental differences**.
- This helps explain why **identical twins look less similar as they get older**.
- Their **methylation patterns** are **more different when older**, so a **greater variety** of **genes** are **switched off**.

Specialised cells

- Different **cell types** (e.g. eye cell and liver cell) have **different methylation patterns**.
- Means that **different cell types** have **different genes switched off** and therefore produce **different proteins**.

Cancer

- So far, you have learned that cancer is caused by **mutation**.
- Cancer can also be caused by **epigenetics**.

Tumour suppressor gene

= stops cell division

↓

Methylation
= cannot be transcribed

↓

CELLS NOT STOPPED FROM DIVIDING

BALL OF CELLS
= BENIGN TUMOUR

AS WE GET OLDER, ENVIRONMENTAL FACTORS HAVE A GREATER EFFECT ON METHYLATION PATTERNS

Vocabulary: The 'omes'

GENOME	The **whole** of the **genetic information** of an **organism**
EPIGENOME	The **methylation patterns** in the **DNA** of a cell
PROTEOME	All the **proteins** produced by a **cell**, **tissue** or **organism**