**Sixth-Form:
Discovering Epigenetics - Making your Mark**

Approximate timing: 55 minutes

Required resources: PowerPoint presentation, fact sheet, lesson plan, activity board(s), DNA strip, cotton reels, glue

This lesson will introduce students to the concept of epigenetics - how reversible modifications to DNA can control access to genetic information. The practical activity explains a sequencing technique called Chromatin ImmunoPrecipitaiton Sequencing (ChIP-Seq), and a software package called Seqmonk, which is used to analyse the data.

The lesson supports:

*AQA GCSE Biology*

4.6.1.4 DNA and the genome

4.6.1.5 DNA structure (biology only)

4.6.2 Variation and evolution

4.6.2.4 Genetic engineering

*EDEXCEL GCSE Biology*

3.4 Describe DNA as a polymer

3.5 Describe the genome as the entire DNA of an organism and a gene as a section of a DNA molecule that codes for a specific protein

3.13 Explain the term: chromosome

*OCR GCSE Biology*

B1.1 What is the genome and what does it do?

B1.2 How is genetic information inherited?

B1.3 How can and should gene technology be used?

*AQA A Level Biology*

3.4.1 DNA, genes and chromosomes

3.4.2 DNA and protein synthesis

*EDEXCEL A Level Biology*

7.2iv Understand that gene expression can be changed by epigenetic modification, including non-coding RNA, histone modification and DNA methylation.

7.2v Know that epigenetic modification is important in ensuring cell differentiation.

*OCR A Level Biology*

5.1.1 Patterns of inheritance

5.1.3 Gene technologies

Links to Babraham Institute research themes:

<https://www.babraham.ac.uk/our-research/healthy-ageing>

<https://www.babraham.ac.uk/our-research/epigenetics>

Links to Babraham Institute scientific services

<https://www.babraham.ac.uk/science-services/bioinformatics>

<https://www.babraham.ac.uk/science-services/sequencing-facility>

Babraham Bioinformatics - <https://www.bioinformatics.babraham.ac.uk/>

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| **Learning outcomes** |
| All students will: | Be able to explain the definition of epigenetics |
| Most students will: | Explain histone modifications and how they regulate gene expression |
| Some students will: | Describe how epigenetics marks can be identified by scientists |
| Key word/s | Epigenetics, histones, nucleosome, DNA, methylation, ChIP-Seq |

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| **Teaching notes** | **Student learning activities**  |
| **Starter or ice-breaker activity** (10 mins)DNA pop quiz – answers are below, refer to fact sheet for more in depth information1. 50 trillion; 200
2. Adenine (A), Cytosine (C), Guanine (G), Thymine (T)
3. Epigenetics add marks to help decide whether a portion of DNA (gene) is switched on (expressed) or off (silenced)
4. Transcription; translation

Methyl (methylation is when a methyl group is added to alter gene expression). Acetyl (Acetylation is when an acetyl group is added to alter gene expression) | Slide(s) 2-7Student actions – answer questions, can discuss in groups. |
| **Development** (15 mins) Run through slides to give a background on:* What epigenetics is
* Why it is important to understand
* How scientists can research epigenetics

The fact sheet and brochure are available for extended information; these work also as handouts. | Slide(s) 7-15Student actions – engage and learn about epigenetics, answer questions where necessary. |
| **Principal Activity** (25 mins)Prior to the lesson, print out the two different boards and DNA strips for students (see attached instructions for measurements). It may also be useful to print out the brochure for the students to refer to for more information whilst carrying out the activity.Facilitate students’ in completing the activity.  | Slide(s) 16-17Student actions – stick together DNA strip from the print-out, and carry out activity using the brochure to refer back to where necessary. |
| Plenary (5 mins)Ask questions on summary slide to assess learning and determine what objectives have been completed | Students answer question(s) on summary slide 18 to assess learning. |
| **Homework**Suggested area of research or follow-up activity | Epigenetics model challengeDNA extraction from strawberriesSweet DNA[DNA origami](https://www.yourgenome.org/activities/origami-dna) |