**Secondary Schools/Sixth Form:**
**Genomics – Decoding DNA**

Approximate timing: 45-50 minutes

Required resources: PowerPoint presentation, fact sheet, lesson plan, activity sheets for game(s).

Summary: This lesson will introduce students to the idea of using genomics to learn more about humans and disease, and what sequencing technologies can be used in biology to decode DNA.

**The lesson supports:**

*AQA GCSE Biology*

4.6.1.4 DNA and the genome

4.6.1.5 DNA structure (biology only)

*EDEXCEL GCSE Biology*

3.4-5,3.21-2 Genetics

*OCR GCSE Biology*

B1.2a-c What happens in cells?

B5.1b Genes, inheritance and selection

*AQA A Level Biology*

3.1.5.1 Structure of DNA and RNA

3.8.3 Using genome projects (A-level only)

*EDEXCEL A Level Biology*

1.4i DNA and protein synthesis

7.1i Using gene sequencing

*OCR A Level Biology*

2.1.3a-b,d,f Nucleotides and nucleic acids

6.1.1a Cellular control

6.1.3a-b Manipulating genomes

Links to Babraham Institute research themes:

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

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

Links to Babraham Institute scientific services

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

https://www.babraham.ac.uk/science-facilities/genomics

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| **Learning outcomes** |
| All students will: | Provide an example of what information DNA can tell us. |
| Most students will: | Be able to describe the structure of DNA and its bonding. |
| Some students will: | Describe the process of sequencing DNA.  |
| Key word/s | Genomics, DNA, sequencing, mutation, nucleotides, genetic code |

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| **Teaching notes** | **Student learning activities**  |
| **Intro to BI** (3 min)Introduce Babraham Institute and its research themes and aims. | Slide 3 |
| **Starter or ice-breaker activity** (5 mins)Identify students’ existing knowledge about DNA, its structure and bonding | Slide 4 & 5 Student actionsDiscuss structure and function of DNA* Double stranded
* 4 nucleotide bases (adenine, thymine, cytosine, guanine)
* Hydrogen bonding between complementary bases holds the strands together
* Sugar-phosphate backbone connects nucleotides in a single strand together, by phosphodiester bonds
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| **Why do we want to know what the DNA 'code’ is?** (3 mins) Discuss with the class what different things DNA can tell us – refer to slide notes & fact sheet | Slide 6 Student actionsDiscuss why it might be useful to know the genetic code?* Learn about diseases
* Identification of people
* Structure of a protein
* Learning how genes control our bodies
* Identify risk genes involved in diseases
* Tailor treatment plans to individual patients (personalised medicine)
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| **What is genomics/sequencing?** (5 mins) Go over slide content – refer to slide notes & fact sheet | Slide 7 – 10Student actionsDiscuss types of mutations sequencing can detect:* Insertions, deletions, substitutions

Why do we want to learn about how a gene is mutated? * To know how the protein may be changed
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| **Sequencing technologies at BI** (10 mins) Go over slide content and discuss advantages with students – refer to slide notes & fact sheet | Slide 11 & 12Student actionsWhy might we want to sequence the entire genome of an organism or just a specific region?* Might be a new organism to identify
* Want to gain more detailed information about a specific gene

Why might we want to sequence separate cells?* More information from one experiment (each cell is now a datapoint)
* The cells might behave differently
* Can combine different samples so you only need to run one experiment (more cost effective)
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| **Decoding DNA Activity** (15-20 mins)Teacher notes: Explain rules of the decoding game (based on mastermind), students can play in twos (1 activity sheet has 2 game sheets) – refer to slide notes & fact sheet for rules | Slides 13Student actionsWork in twos to decode each other’s DNA, taking it in turns to be the code maker and code breaker. |
| **Recap** (2 mins)Recap with students after the game to bring the lesson to a close. Direct them to the links for more information. | Slide 14-15 |
| **Homework/Extension** | Sequence alignment activity for students who complete the decoding DNA game quickly. |