DNA
Lesson Plan

Overview

Deoxyribonucleic acid or DNA is the blueprint for life. It is a natural polymer which contains genetic information, coding for genes producing proteins. The macromolecules of DNA are bundled into chromosomes. DNA is present in the nucleus of every eukaryotic cell (apart from mature erythrocytes) and bacterium. DNA is very similar between different members of the same species and there can be similarities between species which indicate a common ancestor to them on the evolutionary tree.

DNA can be collected and used to identify bacterial pathogens, whether they are dead or alive. If non-toxigenic pathogens are not alive they pose no risk to human health. Carrying out DNA analysis on human samples (e.g. blood, excreta) and food can be used to identify potential sources and spread of outbreaks of human disease.

In this lesson students will model DNA, consider how its structure was first discovered and how this molecule can be used to develop better food safety practices and the limits of using DNA samples to identify food safety hazards.

National Curriculum links

KS3 Working scientifically: Scientific attitudes

- understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review

KS3 Biology: Genetics and evolution

- Inheritance, chromosomes, DNA and genes: heredity as the process by which genetic information is transmitted from one generation to the next
- a simple model of chromosomes, genes and DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model
- differences between species

- the variation between species and between individuals of the same species meaning some organisms compete more successfully, which can drive natural selection

KS4 Working Scientifically: 1. The development of scientific thinking

- the ways in which scientific methods and theories develop over time using a variety of concepts and models to develop scientific explanations and understanding
- explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments

KS4 Working Scientifically: 4. Vocabulary, units, symbols and nomenclature

- developing their use of scientific vocabulary and nomenclature

KS4 Biology: Health, disease and the development of medicines

- bacteria, viruses and fungi as pathogens in animals and plants
- reducing and preventing the spread of infectious diseases in animals and plants

KS4 Biology: Evolution, inheritance and variation

- the genome as the entire genetic material of an organism
- genetic variation in populations of a species
- the process of natural selection leading to evolution
- the evidence for evolution
- the uses of modern biotechnology including gene technology; some of the practical and ethical considerations of modern biotechnology

Starters

Which is the odd one out? (5 minutes) **–** Look at the images and try to get students to determine which is the odd one out by encouraging students to discuss with their peers. Then take their ideas through question and answer until they realise that norovirus is the odd one out as it is significantly smaller, pathogenic and does not contain DNA.

Show-me boards (10 minutes) – Give each student a A4 dry wipe board, pen and eraser. Ask students to draw a typical animal cell and plant cell (extend students by explaining that this is a Eukaryote cell). They should then label the part (s) where DNA can be found. Give instant feedback to the students as they show their work. Weaker students can be

encouraged to look at other people's answers before attempting their own. Encourage more able students to state the mitochondria as well as the nucleus as where the DNA can be found.

Main

Introduce the idea of DNA. Show students the clip from Sci Show about the discovery of DNA and discuss the importance of scientists sharing their ideas and how some people may not get the credit that they deserve. Then ensure that students understand the key terminology by asking them to match the key word with the definition. If an interactive whiteboard is available the virtual pens could be used to draw links between the keywords and their definition.

Lead students through the making of a DNA model using sweets. Students should have four different colours of sweets (one for each base). Explain to students that A is always joined to T and G is always joined to C, so pick colours and make sure they are always in pairs. Using cocktail sticks make models of the base pairs. Then line up the base pairs and attach strawberry laces on to the ends to model the polymer backbone. Now pick up the model and twist it to form the double helix structure. To extend students, look for problems with the model such as base pairs being incorrectly matched and explain that this would most likely cause the cell to die due to the mutation.

Encourage students to consider the limits of this model – DNA is many thousands of base pairs and would be impossible to model on this scale. The human genome is about three billion base pairs, whereas the bacterial genome is between 130,000 and 14 million base pairs. You may wish to encourage students to represent these numbers in standard form.

Plenary

Food safety (10 minutes) – Explain to students how DNA can be used forensically to track disease including foodborne. Then hold a discussion about the advantages and disadvantages of this process. For example, the DNA is often amplified and, if contaminated with DNA from elsewhere, this can lead to false positive matches with other sample DNA.

Reflection (5 minutes) – Ask students to use the think, pair, square technique to decide on the most important fact that they have learnt today.