Vocabulary Focus: Genetic Expressions
Writing Focus: Varying The Sentence Beginning

The Genome and Gene Expression

Vocabulary :

Use the word bank to complete each statement about genetics and heredity.

Phenotype - Punnett square - Gene - heredity - 46 - Genome - chromosomes - genotype - pea mutations - genetics - 23 - DNA - Chromatid - trait - alleles

1. The study of heredity is called _____.
2. The basic molecule of life is called _____.
3. Structures made of DNA and other molecules are _____.
4. Each identical rod in a chromosome is called a(n) _____.
5. A small section of DNA is called a _____.
6. When DNA copies itself, it is not always perfect. The mistakes made are called _____.
7. Different versions of the same gene are called _____.
8. Humans have _____ pairs of chromosomes, making a total of _____ chromosomes.
9. The genetic make-up of an organism is known as its _____. The actual physical expression of those genes is called its _____.
10. _____is the passing of genes from parents to offspring.
11. A(n) _____ is all the DNA in one cell of an organism.
12. A physical characteristic is a _____.
13. A _____ is a chart that shows possible gene combinations.
14. Gregor Mendel was the father of genetics and studied _____ plants.

Reading Comprehension:

Read the text below and answer to the following questions

The human genome is made from DNA. The gene portion codes for proteins and non-coding sections control the expression of genes. An individual's genetic code is unique.

DNA

The genetic material in the nucleus of a cell is composed of a chemical called DNA. DNA is a polymer, a large and complex molecule. It is made up of two strands forming a twisted ladder structure called a double helix. It carries the genetic code, which determines the characteristics of a living organism.

Except for identical twins, each person's DNA is unique. This is why people can be identified using DNA fingerprinting. DNA can be cut up and separated, which can form a 'bar code' that is different from one person to the next.

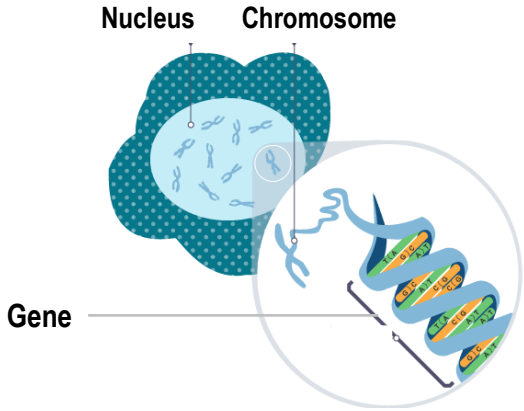
Chromosomes

The cell's nucleus contains chromosomes. These are long, linear threads of DNA, which are made up of many genes. In almost all body cells, chromosomes come in pairs.

Genes

A gene is a small section of DNA in a chromosome. Each gene codes for a particular sequence of amino acids in order to make a specific protein. It is the unit of heredity and may be copied and passed on to the next generation.

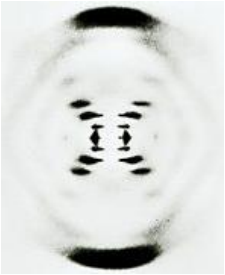
The diagram shows the relationship between the cell, its nucleus, chromosomes in the nucleus and genes.



DNA structure

The structure of DNA:

James Watson and Francis Crick worked out the structure of DNA in 1953. By using data from other scientists (Rosalind Franklin and Maurice Wilkins) they were able to build a model of DNA. The X-ray crystallography data they used showed that DNA consists of two strands coiled into a double helix.



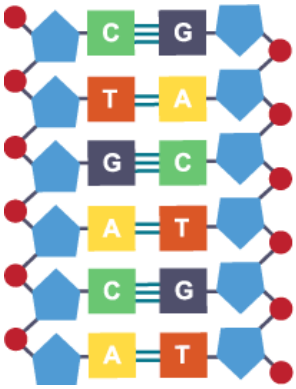
The famous X-ray diffraction photograph of DNA taken by Rosalind Franklin, known as photograph 51

DNA is a polymer made from four different nucleotides. These are arranged in a repeating fashion. Each nucleotide consists of alternating sugar and phosphate sections with one of the four different bases attached to the sugar.

Base pairs

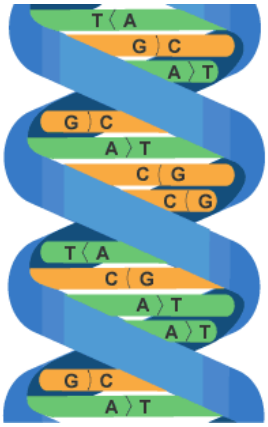
Each strand of DNA is made of chemicals called bases. Note that these are different from bases in relation to acids and alkalis in chemistry.

There are four different bases in DNA: thymine, T adenine, A guanine, G cytosine, C
There are chemical cross-links between the two strands in DNA, formed by pairs of bases. They always pair up in a particular way, called complementary base pairing:
thymine pairs with adenine (T–A)
guanine pairs with cytosine (G–C)



A visual to describe the base pairs in DNA.

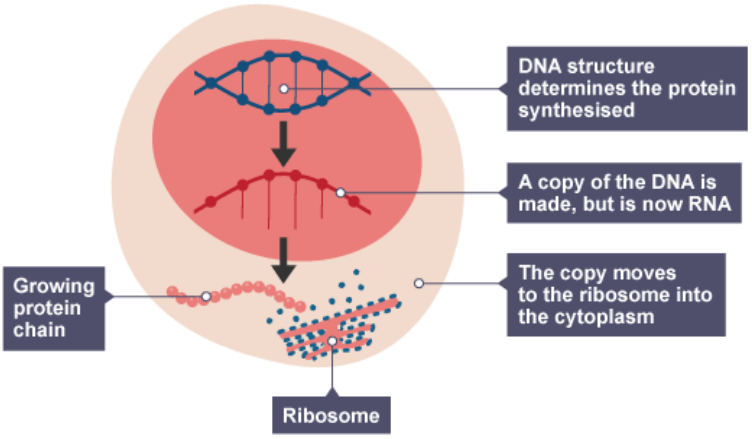
A sequence of three bases is the code for a particular amino acid, which is known as a triplet or the triplet code. The order of the bases controls the order in which amino acids are assembled to produce a particular protein.



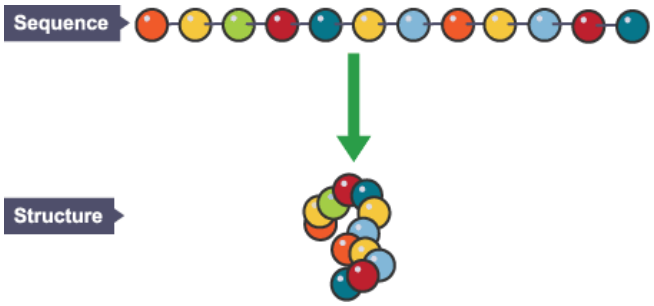
Base pairs on a section of DNA

Protein synthesis - Higher

Greg Foot explains how the structure of DNA affects the proteins made in DNA synthesis
The DNA code for the protein remains in the nucleus, but a copy of a gene, called mRNA, moves from the nucleus to the ribosomes where proteins are synthesised in the cytoplasm. The protein produced depends on the template used and if this sequence changes a different protein will be made. Carrier molecules bring specific amino acids to add to the growing protein in the correct order. There are only about 20 different naturally-occurring amino acids.
Amino acids are connected together in a specific order at the ribosome (see diagram) to create a specific protein molecule. Every three bases on the mRNA code, codes for one amino acid.



Each protein molecule has hundreds, or even thousands, of amino acids joined together in a unique sequence. It is then folded into the correct unique shape.
Different variant or alleles of the gene result in the amino acids being assembled in a different order. This would change the shape of the protein and could stop it working or make it work in a different way.



Effect of genetic variants on phenotype - Higher

The structure of DNA is important in synthesising specific proteins needed in biological processes.
Not all parts of the DNA code for proteins, there are coding and non-coding parts of DNA. The coding DNA contains the instructions to make all the proteins needed. The non-coding DNA has an important role in switching genes on and off, so variations in these areas may affect gene expression and if the correct protein is synthesised or not. In humans it is about 80 per cent non-coding and 20 per cent coding.
The diagram below shows DNA with certain genes switched on and some switched off:

Red boxes - genes switched on, white boxes - genes switched off

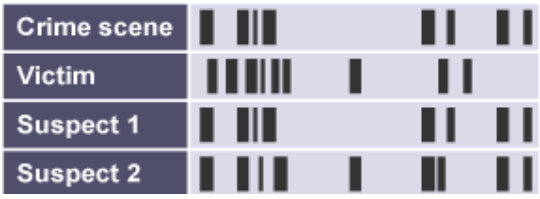
In different cells around the body, genes will be switched on and others will be switched off. This will vary depending on which cells are examined.

Genetic profiling

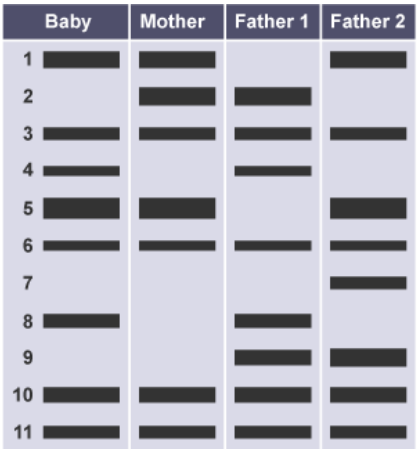
In the human genome, there is a small amount of DNA that is unique to individuals.
By cutting a sample of DNA into fragments using enzymes it is possible to make a characteristic profile of DNA bands for individuals. This technique is called DNA profiling, and is a technique used to determine paternity. It can help solve crimes where the suspect may have left a sample of body tissue at the crime scene. It can also be used in other organisms to compare different species for classification purposes.

Using DNA profiling in solving crimes

DNA is often left at the scene of a crime - it is found in blood, skin and even hair. Once the DNA has been isolated from the victim and if suspects are identified then DNA profiling can be useful in placing a suspect at the scene of the crime.



Using DNA profiles to determine paternity



To determine paternity, the DNA profiles of both mother and baby must be known. Any band that can be seen in the baby's DNA, which cannot be seen in the mother's, must be found in the DNA of the father or paternity cannot be confirmed.

DNA profiles can also be used to identify alleles associated with particular genetic disorders. Neonatal testing carries out this process to look for disorders such as cystic fibrosis. The early identification of this and other genetic disorders results in early treatment, which can reduce the impact of the disorder on the life of the sufferer.

Genetic profiling can be controversial. The table below summarises some of the advantages and disadvantages of using this technique.

Advantages	Disadvantages
DNA evidence is reliable as it is highly unlikely that two people would share the same profile, except in the case of identical twins	Some people are concerned that DNA could potentially be used by insurance companies or employers used to discriminate against people with genetic conditions
DNA profiles can be used to determine paternity	Storage of DNA profiles can be seen as an invasion of privacy
DNA profiles can be used to identify genetic disorders early	Theft of DNA profiles from a database is a threat
DNA profiles can be used to place suspects at a crime scene	It is possible to plant DNA at a crime scene, giving false evidence, or an innocent person's DNA might be at the scene even though they had nothing to do with the crime

The human genome

The genome of an organism is the entire genetic material of that organism. The whole human genome has been studied and this has great importance for medicine.

In order to exploit its secrets, it is vital that the human genome is fully understood.

It enables us to:

- search for genes linked to different types of disease
- understand inherited disorders and their treatment
- trace human migration patterns from the past

Scientists are searching for disease associated genes. One example is the genes that can contribute to breast cancer, which are known as BRCA1 and BRCA2. Mutations in these genes account for approximately 10 per cent of all inherited breast cancer cases detected.
Scientists detected BRCA1 and BRCA2 genes by studying individuals in families known to have inherited breast cancer. They were able to create a pedigree analysis, which is similar to a family tree diagram that showed the close relationship of those affected and unaffected within the family.
The pedigree analysis illustrates the inheritance pattern of the disease. This enables scientists to test DNA of the affected and unaffected individuals to identify differences. It is now possible to detect the presence of the genes by having a simple blood test.

Practical - Extraction of DNA from living material

Aim
In this practical you will extract the DNA from strawberries. Strawberries can have up to eight copies of each chromosome and so contain a lot of DNA. When extracted from the strawberry this volume of DNA means it is visible to the naked eye as white threads.

Method

1. Put the strawberry into the plastic bag, seal it and crush for about 2 minutes.
2. Mix together 10 cm^3 of washing up liquid, 1 g of salt and 100 cm^3 water in a beaker. This mixture will break down cell membranes and release the DNA.
3. Add 10 cm^3 of the extraction liquid to the bag with the strawberry. Mix together for 1 minute.
4. Filter the strawberry mixture.
5. Pour 10 cm^3 of ice-cold 90% ethanol down the side of the beaker into the strawberry mixture, do not mix or stir. The DNA will separate out into this layer.

Within a few seconds you should see a white cloudy substance form in the clear layer above the strawberry mixture. Use a lolly stick to pull strands of this out of the top layer. This is the strawberry DNA.

Questions: tick the right answer

1. The 'backbone' chains of a DNA molecule are made of which chemicals?
   a) Sugar and protein
   b) Sugar and phosphate
   c) Phosphate and protein

2. The nitrogenous base cytosine only pairs with which other base?
   a) Adenine
   b) Thymine
   c) Guanine

3. The DNA code is a:
   a) Double code
   b) Triplet code
   c) Quadruple code

4. What are the different versions of a gene called?
   a) Chromosomes
   b) Bases
   c) Alleles

5. What effect does a change in the order of the bases in DNA have?
   a) Amino acids are connected in the same order
   b) The amino acids form a different protein
   c) The amino acids do not form a protein

6. What is the percentage of coding to non-coding DNA in the human genome?
   a) 60% coding to 40% non-coding
   b) 80% coding to 20% coding
   c) 20% coding to 80% non-coding

7. What function does the non-coding DNA have in the human genome?
   a) It controls when cell replication takes place
   b) It controls lipid synthesis
   c) It controls which genes are switched on and off

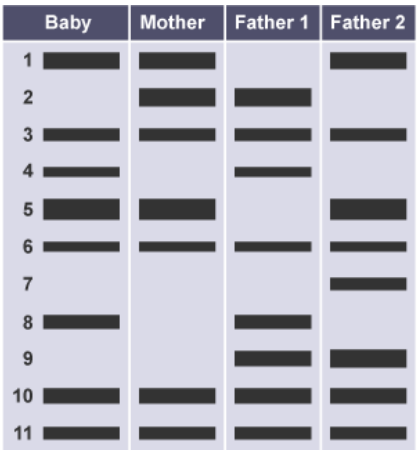
8. Which of these is a use of genetic profiling?
   a) To produce insulin for diabetics
   b) To determine paternity of a child
   c) To cure cancer

9. Which of these is a disadvantage of genetic profiling?
   a) Insurance companies might get hold of the information and exploit it
   b) Extraction of DNA is a dangerous process
   c) DNA might spread and cause disease

10. Why is it important that scientists study the human genome?
   a) To allow people to design their own children
   b) To give information to insurance companies
   c) To search for genes linked to different disease

11. In the example below, which suspect has left their DNA at the crime scene?

12. In the example below, is father 1 or 2 the father of the baby?



Writing:

Varying Sentence Beginning

Starting every sentence with a noun, pronoun or noun phrase can make your writing extremely repetitive and boring. In order to make your writing more complex and fluent, you should learn to vary the structure and beginnings of your sentences.

➢ Start with a PREPOSITIONAL PHRASE:	***With** a smile*, *Ken ran the race knowing he would win.*
➢ Start with a PARTICIPLE (-ing /-ed) PHRASE:	***Knowing** he would win, Ken ran the race with a smile.*
➢ Start with a DEPENDENT CLAUSE:	***Because he knew he would win**, Ken ran the race with a smile.*

➢ Start with an ADJECTIVE / ADVERB:	***Happily***, *Ken ran the race knowing that he would win.*
➢ Start with an INFINITIVE:	***To win***, *Ken ran the race smiling, sure of his success.*

LET'S PRACTICE

Revise the following sentences by varying their beginnings.

■ Use the notes in parentheses to determine whether the sentence should start with: adjective/ adverb, infinitive, participle phrase, dependent clause or a prepositional phrase.

1. The public was highly entertained by silent films in the early days of moviemaking. (Prepositional phrase)

➢ _____

2. The stars of these first films had to be very expressive in their use of gestures because there was no dialogue. (Dependent clause)

➢ _____

3. Moviemakers congregated in Hollywood, California, and developed a film community. (participle phrase)

➢ _____

4. Someone usually played a piano in the theater to accompany the action in the film. (infinitive)

➢ _____

5. Humans bonded with wolves originally. (Adverb)

➢ _____

Rewrite the following sentence, using different sentence openings.

Jacqueline called Marilyn to ask her if she wanted to meet at the library to study for an upcoming biology exam.

➢ _____

➢ _____

➢ _____

➢ _____

➢ _____

Rewrite the following paragraph, combining sentences and using a variety of sentence structures.

My cousin enjoys her job. She is a counselor at a summer camp. She teaches crafts during the day. She sleeps in a cabin with ten-year-olds. She says that some of them are homesick at first. They usually get over it after a couple of days.

_____

_____

_____

_____

_____