

Inheritance



L1 Environmental vs genetic variation

Tigers and octopuses look very different. They are clearly different species. Lions and tigers however are more similar, but both are still quite different. They are clearly both cats, but they are different species of cat. If we got two tigers, they would both look different too, but they would be the same species.

Members of the same species are all similar but do show differences. Humans are a species, and each of us looks different – eye colour, height and shoe size are all examples of the differences between individuals. Even identical twins have different fingerprints! The scientific term for these differences is “variation”.

Variation is important for the survival of species; it allows those best suited to the environment to survive. This is a driving force behind a process called natural selection which leads to the evolution of new species over very long periods of time. For example, in a population of rabbits the rabbits with the biggest ears will survive and have baby rabbits. Over time all the rabbits will have bigger ears.

You look different to the person next to you (unless you are identical twins), and you like different to the other people in the class. This is because you have different biological parents and have inherited characteristics from them, in the form of genes which are your DNA. Even siblings, aside from identical twins, do not look identical because they do not inherit exactly the same DNA as each other. They may look very similar but not identical.

However not all variation is inherited. For example, a person with pink hair did not inherit that hair colour, neither did a person with tattoos. These are examples of environmental variation.

Some characteristics are affected by both genetics and the environment. For example skin colour. A person’s skin colour will be in part due to the genes they inherit, but if they spend a lot of time in the sun they may tan. Another example is height, a person will have the genes to reach a certain height, but if they don’t eat enough food it may stunt their growth.

Independent practice

1. Mittens had 4 kittens, what word is used to describe the differences between the kittens.
2. What can cause variation?
3. What type of variation is due to the parents?
4. What type of variation can a person influence in their own life time.
5. **Extended writing (paragraph needed)** Explain the difference between the two types of variation.
6. List at least 5 examples of variation between dogs.
7. Explain why you look different to other people in the class.
8. Explain why two identical twins may end up different heights.
9. State and explain other reasons why identical twins may look different.
10. Caleb and Callum are brothers, explain all the possible reasons why they might look different.
11. Explain why a person does not look identical to either parent.
12. **Extended writing (paragraph needed)** Explain the link between variation and evolution.
13. Several studies on identical twins have taken place over many years. They often find that they twins end up with similar lifestyles. What does this suggest about the importance of the environment vs genetics.
14. Often siblings in the same household with the same upbringing can be very different, what does this suggest about the importance of genetics vs environment for personality.

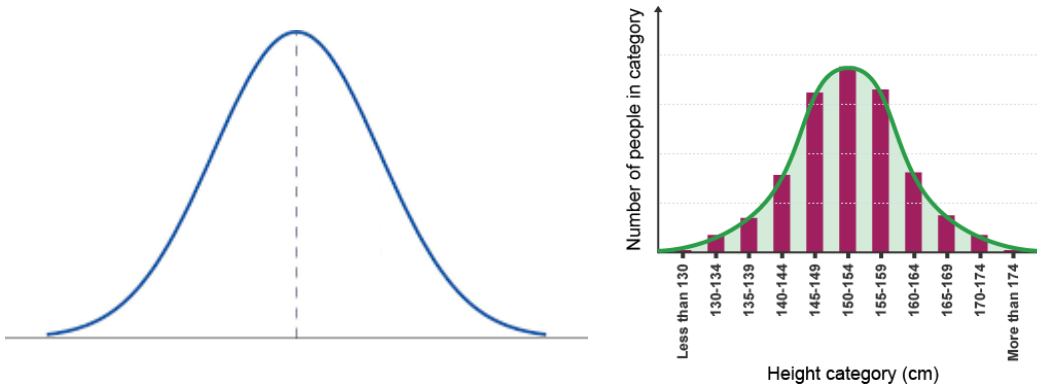
L2 Continuous vs discontinuous variation

Last lesson we saw not only why different species look different but why not all humans look the same, due to differences in genetic and environmental variation. Variation can be split into two categories, continuous or discontinuous.

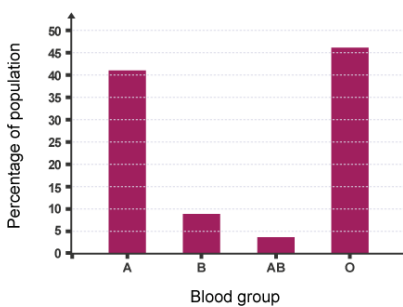
Continuous and discontinuous variation are ways we can understand how traits or characteristics differ among people. Let's think of it like a fun game of building blocks.

Continuous variation is like having a lot of blocks that smoothly connect together. Imagine a tower where each block is a little bit taller or shorter than the one before it. Traits like height or weight work this way – there's a range, and people can be a little bit taller or shorter, a little heavier or lighter, creating a smooth flow of possibilities. Continuous variation is usually caused by both inheritance and your environment.

A graph of continuous variation often has this classic shape known as a bell curve.



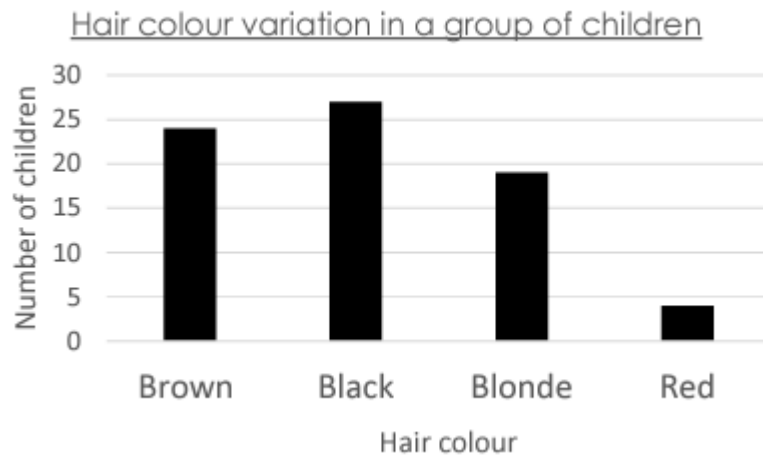
Now, discontinuous variation is more like having different sets of blocks that don't mix together as smoothly. Think of these as distinct groups or categories, like blocks that are all red, blue, or green. Traits such as eye colour or blood type fall into this category – you either have blue eyes or brown eyes, and there's no in-between. Discontinuous variation is usually only caused by inheritance. If you record the blood groups of a group of people and draw a graph of your results, it usually looks something like this:



So, continuous variation is like a gradual change, where traits blend smoothly, and discontinuous variation is about distinct groups or categories, like separate sets of blocks.

Independent practice

1. Give the 4 words used to describe variation.
2. What words are used to describe the causes of variation.
3. Explain the difference between continuous and discontinuous variation.
4. What type of variation will the ability to roll your tongue be?
5. **Extended writing (paragraph needed).** State 5 types of variation that are in this classroom, describe the cause of the variation and if the variation is continuous or discontinuous.
6. Both continuous and discontinuous variation are drawn as what type of graph?
7. What shape is used to describe the shape of a graph with continuous data.
8. What usually causes continuous variation.
9. What usually causes discontinuous variation.
10. There was an investigation into hair colour variation in a group of children. This graph shows the results.
 - (a) How many children have red hair
 - (b) Is this variation continuous or discontinuous? Explain how you know.

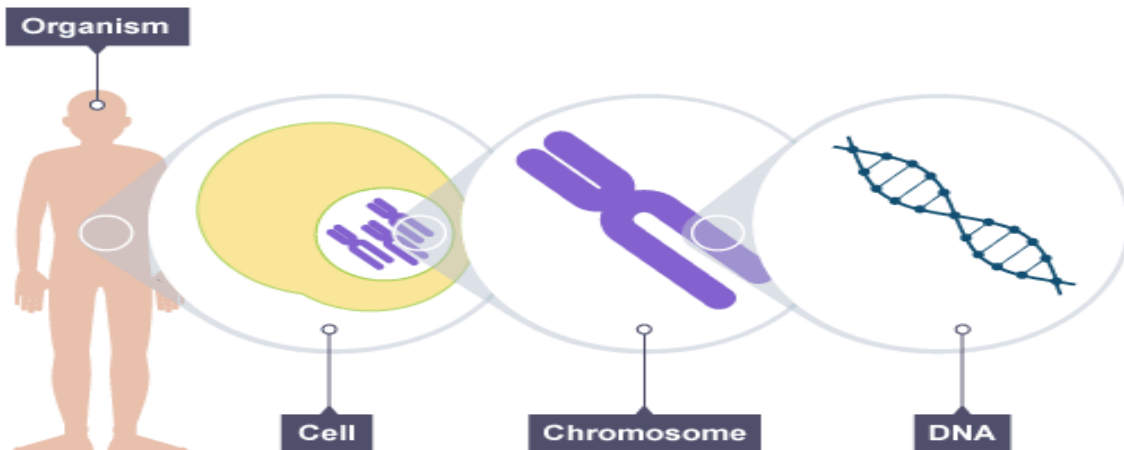


11. Dogs have different colour fur, what type of variation will this be and why?
12. State what type of variation tail length in cats would be and why.
13. Will a graph showing eye colour in this classroom have a bell curve shape or not? Explain why.
14. **Extended writing (paragraph needed)** Explain how to collect data and plot a graph showing eye colour variation in this classroom.

L3 Structure of DNA

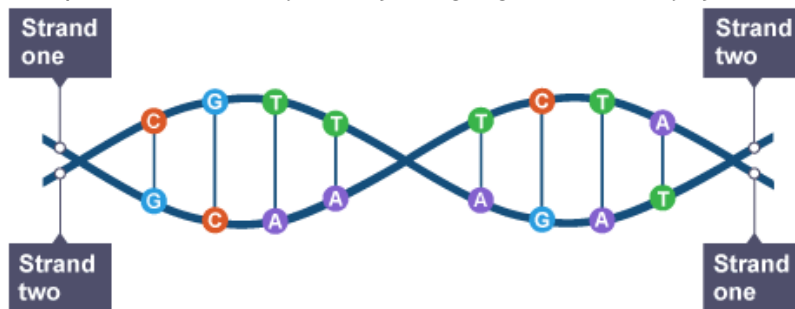
We have referred to genes multiple times so far this unit, and that they are inherited from our parents, but we have not gone into too much detail about what genes are. To understand genes, we need to know about the structure of DNA.

The DNA of an eukaryotic organism is found in the nucleus. Humans are eukaryotic organisms so this means that our DNA is found in the nucleus of our cells, in structures called chromosomes. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure.



In a DNA molecule:

- there are two strands
- the strands are twisted around each other to form a double helix
- There are 4 bases of DNA: Adenine, Thymine, Cytosine, Guanine.
- Base pairs are formed by bases joining together, C always joins to G and A to T

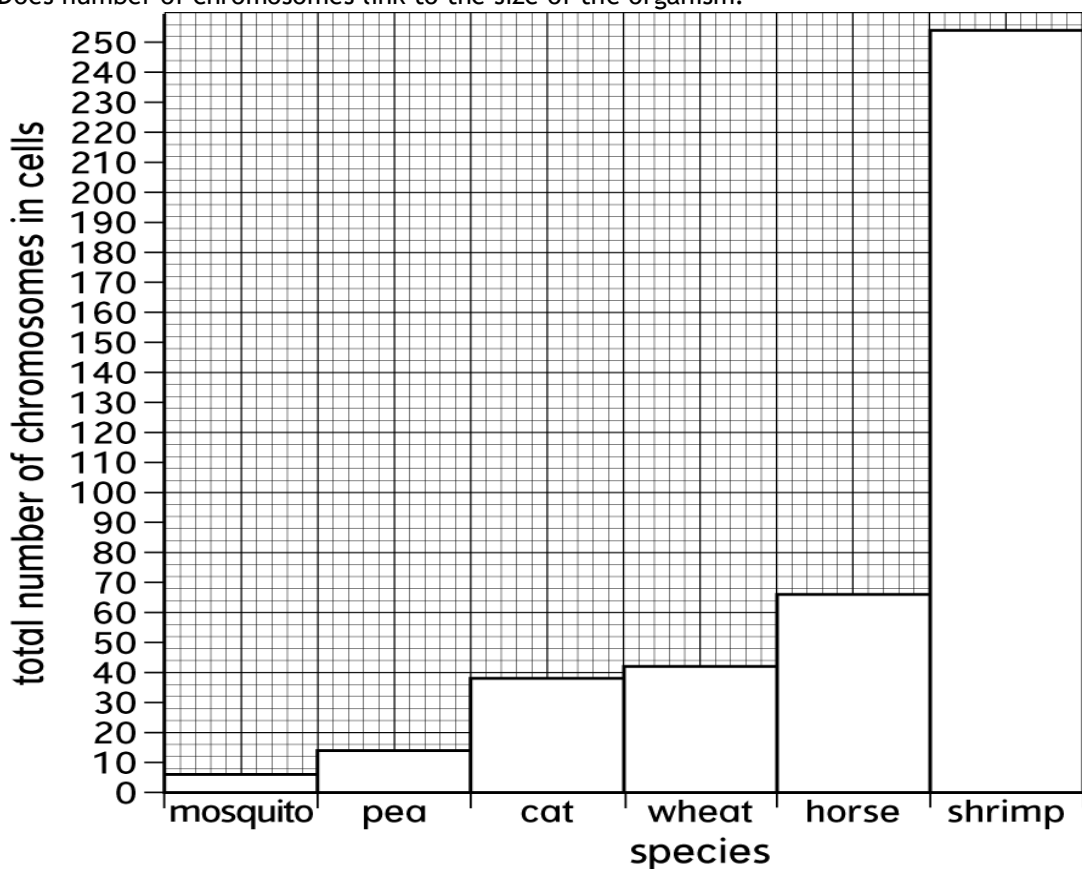


A DNA molecule showing its base pairs, G-C and A-T

A gene is a small section of DNA that codes for one protein. Every person has two copies of each gene, one inherited from each parent. Different versions of the same gene, called alleles, will have different sequences of bases. The genome is all of the genes inside a person's body. It is estimated that humans have between 20,000 and 25,000 genes. Only some of these genes code for characteristics like hair colour, eye colour etc. Some traits will be controlled by only one gene, and others will be controlled by multiple genes.

Independent practice

1. Where do we find all our DNA in humans? **Blood, fingerprint, hair strand, skin cell**
2. What does it mean if an organism is eukaryotic?
3. What is DNA?
4. What is a chromosome?
5. **Extended writing (paragraph needed)** Describe the structure of DNA in human cells.
6. All organisms have an even number of chromosomes in their body cells. Why is this?
7. Most cells contain two sets of chromosomes which can be sorted into pairs. Some chromosomes are bigger than others and so the pairs can be arranged in size order, apart from the last two. Would you expect to find more, less or the same number of genes in a bigger chromosome?
8. Look at the graph below.
 - a. What type of graph is it?
 - b. How many chromosomes does a body cell in a cat have?
 - c. Which species has 66 chromosomes in its cells?
 - d. Does number of chromosomes link to the size of the organism?



Numbers of chromosomes in the body cells of different species.

9. Does an adult have more, less or the same number of genes as a baby?
10. **Extended writing (paragraph needed).** Explain what will be different between the genes for a person with blue eyes and a person with brown eyes.
11. Why do scientists want to know the function of all the genes in the human genome?
12. Suggest why we do not know how many genes are in the human body?
13. The DNA of any two people on Earth is 99.6 percent identical. Suggest why we do not look almost identical.
14. Humans have less genes than a tomato. Does this suggest a link between the number of genes and how complex an organism is?

L4 Discovery of DNA

Our story takes us back to the 1950s, a time when scientists were on a quest to unravel the mysteries of DNA, the magical code that holds the secrets of life. In this tale, we'll meet some remarkable scientists who played a part in this discovery, including Rosalind Franklin, a brilliant woman whose contributions were both crucial and unrecognized. Rosalind Franklin lived and worked in an era when gender bias was prevalent in the scientific community. As a woman, she encountered obstacles in gaining the recognition and respect that her male counterparts often received.

James Watson and Francis Crick, two scientists from England, were determined to solve the puzzle of DNA. Around the same time, Rosalind Franklin, a talented scientist, was also studying DNA. She used a powerful tool called X-ray crystallography to take photographs of the molecule. One of her most significant achievements was a photograph known as "Photo 51." This photo held a crucial clue about the structure of DNA.

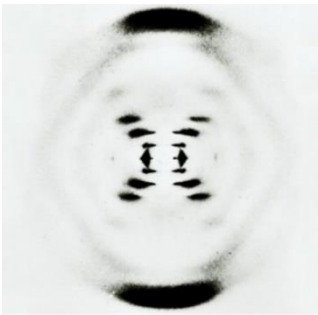


Photo 51 a snapshot capturing the shadowy outlines of the double helix, the twisted ladder shape of DNA.

James Watson and Francis Crick were aware of Rosalind Franklin's work, but they didn't have direct access to her findings. Instead of collaborating, they sought information through other channels. One of their colleagues, Maurice Wilkins, who worked in the same laboratory as Rosalind, had seen her research. Maurice Wilkins showed Watson and Crick a critical piece of information – he shared Rosalind Franklin's photograph, Photo 51, without her knowledge or permission.

Watson and Crick used the information from Photo 51, along with their own research, to construct a model of the DNA molecule. In 1953, they published their groundbreaking discovery, revealing the double helix structure of DNA.

The sad part of our tale is that Rosalind Franklin's contribution wasn't fully acknowledged at the time. Her name wasn't included in the original publication by Watson and Crick. It took years for the scientific community to recognize and appreciate her crucial role in the discovery of DNA's structure.

As the years went by, Rosalind Franklin's work gained the recognition it deserved, and her contribution became an essential part of the story of DNA. The scientific community began to appreciate her skills and dedication, acknowledging the significance of Photo 51 in unlocking the secrets of the double helix.

Independent practice

1. Who were the main characters in our story about the discovery of DNA in the 1950s?
2. Why was Rosalind Franklin an important scientist in this tale?
3. **Extended writing (paragraph needed)** Explain the challenges faced by Rosalind Franklin.
4. What was the tool that Rosalind Franklin used to study DNA, and what was one of her significant achievements with it?
5. Describe Photo 51 and its role in understanding the structure of DNA.
6. Who was Maurice Wilkins, and what role did he play in the story?
7. What did Maurice Wilkins do that became a source of controversy in the tale?
8. **Extended writing (paragraph needed)** How did James Watson and Francis Crick contribute to the discovery of the DNA structure?
9. Describe the double helix shape of DNA.
10. Why do scientists need to work together and share information, like in the story of DNA's discovery?
11. Why is it important for people to give credit to others who help them with important discoveries, like James Watson and Francis Crick with Rosalind Franklin?
12. If Rosalind's work had been recognized at the same time as Watson and Crick, how do you think science might be different today?
13. Do you think that Watson, Crick and Wilkins should or should not have received the Nobel prize?
14. Explain why scientists are still studying DNA.

