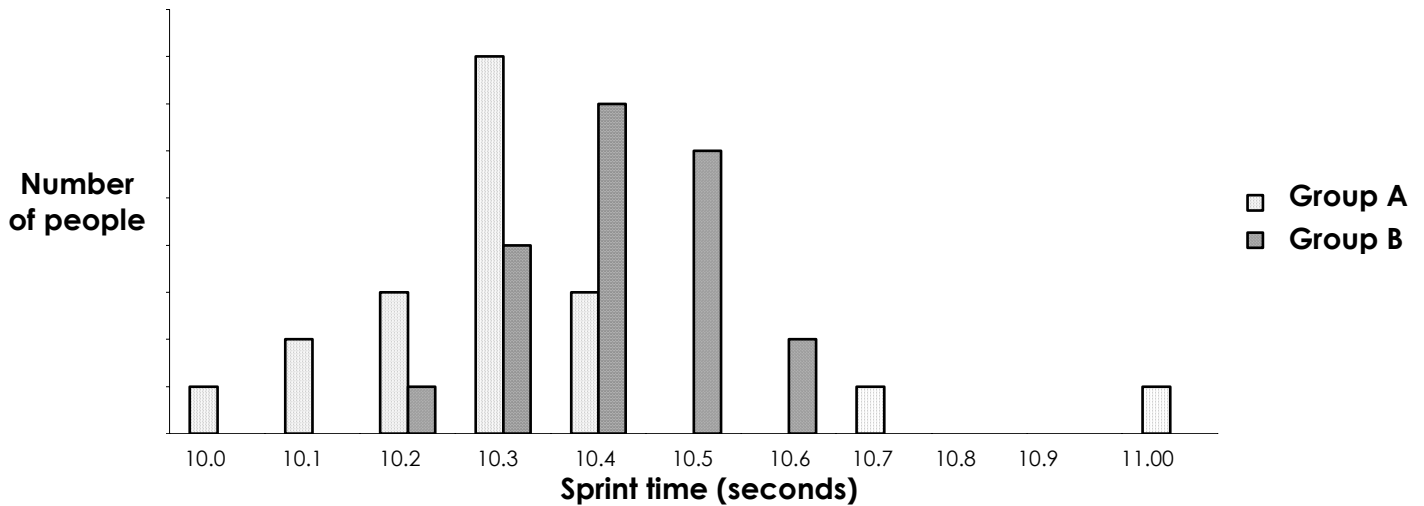


Variation within a species

This graph shows the times two groups of people took to run a 100m sprint. The groups were chosen on the basis of some physical differences.



- What is the most common result (mode) for each group?
- What is the difference (in seconds) between the most common results (mode) for each group?
- What differences could there be between the two groups of people?
- Who do you think will have the closest times – any two individuals from the same group or any two individuals from different groups?

The table shows you the sprint times for some individual people from both groups.

Runner	Group	Time (seconds)
P	A	10.3
Q	B	10.4
R	A	11.0
S	B	10.4
T	A	10.3
U	B	10.5

- What is the difference in sprint time between:
 - runners P and R?
 - runners S and U?

- Compare these answers to the difference you found in sprint times between each group.

The differences between individuals from the same race can for some things be much bigger than the difference between two individuals from different races. This surprises some people.

What's a species?

These dogs belong to the same species because they can reproduce together.

When animals of the same species look different, scientists classify them as different subspecies or races. They can still reproduce together.

- What does the word species mean?
- Do all people belong to the same species?



Scientists have different opinions about what the word 'race' means. Some different definitions found on different websites are given below:

For two people 85% of the differences between them are because we are all individuals. Only 15% can be because we come from different races.

In science the word 'race' means that you have to be able to tell 75% of individuals in one race apart from all the individuals in another race.

Organisms can only be put into different races if more than 90% of their features are different. Different races of living things usually develop if groups are separated from each other and don't get the chance to breed together e.g. by high mountains.

In your groups discuss the following questions. Write down arguments for and against the ideas. Try to listen to everyone's ideas and reach an agreement if you can.

- Some scientists say that there is no such thing as different human races. Do you think this is right?
- What do you think people mean when they use the word "race" in every day conversation?
- Is race a useful way of distinguishing people in our country?

Produce a presentation to summarise the ideas you have discussed.

Continuous variation

Differences

Obviously there are differences between people from different ethnic groups of the world. Skin colour is a common feature that people use to decide what culture they think a person belongs to. A person's features are partly controlled by what genes they inherit from their parents.

- Discuss in groups what colour skin the parents of these children might have.
- How certain are you? If you're not 100% sure, why not?



Some features are controlled by just one pair of genes. These features are something people either have or they don't. This is called discontinuous variation. For example, your blood type – there are no in between blood types. Gender is an example of discontinuous variation that is the responsibility of a whole chromosome.

Other features like skin colour show a whole range between people. We call this continuous variation – a feature that has a wide range in different people. These features are controlled by several genes working together. How you inherit them is more complicated.

Your environment can also make a difference to some features. For example, you can dye your hair to change the colour. You may need someone else to teach you how to do something, like play a musical instrument.

- **Write down ten human features. For each one say whether you think they are controlled by genes, or by environment, or by a mixture of both.**

Inheriting skin colour

Several genes control your skin colour, so it is not possible to predict exactly what colour skin a child will have if his or her parents have different skin colours, or even if parents have the same skin colour. Children sometimes have very different skin colour to their parents because they have inherited skin colour genes that did not show up in the parents.

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Your environment can also make a difference to some features. For example, you can dye your hair to change the colour. You may need someone else to teach you how to do something, like play a musical instrument.

- **For each feature in the table decide if you think they are controlled by genes, or by environment, or by a mixture of both. Tick the box you agree with.**

Feature	Genes	Environment	Both
eye colour			
blood type			
sex			
hair colour			
freckles			
scars			
good at music			
fast sprinter			

Inheriting skin colour

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Skin colour



Skin colour is produced by a pigment in cells called melanin. Melanin protects the genes in the cell nucleus from damage by UV rays. This sort of damage can cause a change in the gene called a mutation. Mutations in skin cells may produce skin cancer.

There are two shades of melanin, red/yellow and brown/black. Another yellow/orange pigment called carotene also colours the skin. Black African skin contains high levels of melanin. Asian skin has medium levels of melanin and more carotene than white skin. White skin has low levels of melanin although melanin patches produce freckles and moles.

Modern humans first developed in Africa. Evidence suggests that their skin was black.

- Read the first paragraph carefully. What advantage is there in having black skin?

Vitamin D is made in skin cells. This only happens when enough UV light reaches the skin cells.

- What does the body need vitamin D for?
- What problems could be caused by a lack of vitamin D?
- What advice would you give to someone who was worried they might not be making enough vitamin D?
- As modern humans moved into cooler climates and developed in these places, some groups lost their dark skin colour. Why do you think this may have happened?

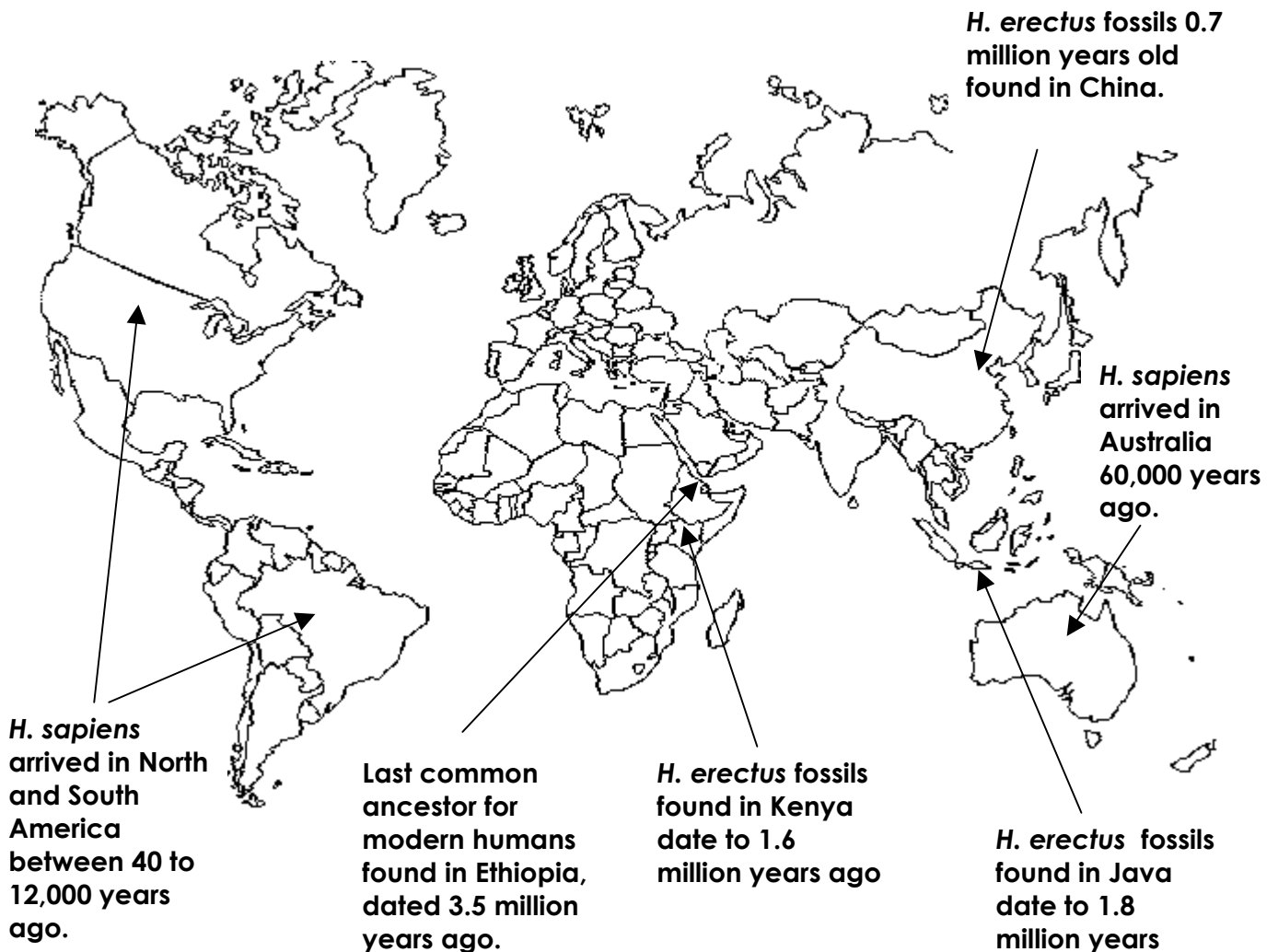
Extension

Living things can become different because their genes change. We call these changes mutations. Usually they are harmful. Very rarely a mutation can be of benefit to an organism. Do some background reading about mutations. How could mutations have been involved in changing skin colours?

Human evolution

People around the world have different beliefs about how human beings came to be on Earth. There are different religious and scientific beliefs.

Most scientists believe in a process called evolution. Evolution is when living things gradually change over millions of years. All plants and animals are given a two-word scientific name, printed in *italics*. Modern humans are *Homo sapiens*, or *H.sapiens* for short.



The evidence

Fossils are hard parts of animals and plants that have been buried and turned into rock. Bones and teeth are the main evidence scientists use to build up a picture of human evolution. Fossils of humans are very scarce. Ideas on human evolution can change dramatically when new fossils are found.

Meet your ancestors

8 million years ago Africa was covered with green forests. Many different species of apes lived there. About 6 million years ago the climate cooled and the forest thinned to grassland and open woodland. Many of the ape species became extinct. A few of them survived.

Species	Where?	When?	Diet?
<i>H. erectus</i>	Africa, Asia, Europe	1.8 million to 300 thousand years ago	Ate some meat
<i>H. habilis</i>	Africa	2.3 to 1.7 million years ago	Possibly ate meat
<i>H. sapiens</i>	Worldwide	100,000 years ago to today	Ate meat and plants
<i>Australopithecus afarensis</i> – the first species to walk on two legs (<i>A. afarensis</i>)	East Africa	3.9 to 3.0 million years ago	Vegetarian
<i>H. neanderthalensis</i>	Europe and Western Asia	200,000 to 30,000 years ago	Mostly meat eaters

The table shows some species of humans and some of their ancestors.

- Put the species in the order they appeared, starting with the earliest.
- Humans have evolved in many ways over millions of years.
 - a) Explain what evolved means.
 - b) Give examples from the table of how humans have evolved.
- Which appears to have been the first species to leave Africa?
- Put in order the places that human ancestors spread to after that.
- There is evidence that several different species of early human lived at the same time. The only one which survived was our own, *H. sapiens*. Can you suggest why?

Very few human ancestor fossils have been found, but there seem to be ten or twelve different species – and new discoveries are being made all the time. Finding all these other fossils tells us something very important about human evolution. It didn't happen in a straight line. For example, the ancestors of *H. erectus*, *H. neanderthalensis* and *H. sapiens* were evolving at the same time.

- Draw a branching tree diagram showing which species evolved and which died.

Human evolution

Species	Where?	When?	Diet?
Australopithecus afarensis – the first species to walk on two legs (<i>A. afarensis</i>)			
<i>H. habilis</i>			
<i>H. erectus</i>			
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<i>H. neanderthalensis</i>			
<i>H. sapiens</i>			

Inherited diseases

Haemophilia is an inherited blood disease. It is caused by a faulty gene that stops your blood clotting properly if you are cut. It affects about 1 in 10,000 men. It affects very few women. This figure is the same for countries across the world.

Sickle cell anaemia is a different inherited disease that affects red blood cells in men and women. Sickle cell anaemia is caused by a different faulty gene. We inherit two copies of every gene, one from each parent. If both parents pass on the sickle cell gene, their child will develop sickle cell anaemia.

Research the symptoms of sickle cell anaemia. Also look for parts of the world where it is most common. Try these websites:

www.bbc.net.uk/health/ask_doctor/sickle_cell.shtml

<http://mrcjamaica.nimr.mrc.ac.uk>

Symptoms – keywords: haemoglobin, red blood cell, shape, oxygen

- From your research which people in the UK are most likely to have the gene for sickle cell anaemia?

People who have one sickle cell gene and one normal gene for haemoglobin don't have sickle cell anaemia. What's interesting is that these people are protected from getting malaria.

Malaria is common in hot, tropical areas where mosquitos are found.

- Is there a link between where malaria is found and where sickle cell disease is common?
- Can you suggest why different genes evolve around the world?



Malaria is caused by a microorganism. Mosquitos feed on blood. If they've fed on an infected person they can pass on the microorganism to other people.

Sickle cell anaemia

Red blood cells contain a chemical called haemoglobin. Haemoglobin carries oxygen around the body. In sickle cell disease, the haemoglobin is different to normal haemoglobin. Although it can still carry oxygen, it tends to crystallise when it releases the oxygen. This causes the shape of the red blood cell to distort into a sickle shape, instead of a doughnut shape. This distortion prevents the smooth flow of blood in the narrow blood vessels, leading to blockages. A blockage causes a sickle crisis, which can damage organs in the body. A crisis is also very painful. A crisis may be induced by infections, dehydration, over-exertion, over-excitement, exposure to cold, and even bumps and bruises. In adults, stress can also induce crises.

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