KS3 Science Independent Learning Booklets

Inheritance

If you have internet at home, you can use bitesize to help you with some of the activities.

Try your hardest to work through the booklets

INHERITANCE & GENETICS

Genetic information is passed from one generation to the next. This is called heredity and why we resemble our parents. The genetic information itself is contained in a complex molecule called DNA .
A DNA molecule:

- there are two strands
- the strands are twisted around each other to form a double helix
- the strands are held together by bonds between base pairs

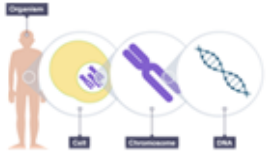
A DNA molecule showing its base pairs, G–C and A–T

Watson, Crick, Wilkins and Franklin worked out the structure of DNA using crystal chromatography in the 1950's.

The DNA in all of your cells is approximately two metres long. Because it is so long it is very thin and coiled into structures called chromosomes. The chromosomes are found in the nucleus of each cell.

Human body cells each contain 23 pairs of chromosomes, half of which are from each parent. So, human gametes (eggs and sperm) each contain 23 chromosomes. When an egg is fertilised by a sperm, it becomes a cell with 23 pairs of chromosomes. This is why children resemble both their parents – half of their chromosomes and DNA come from their mother, and half from their father.

A gene is a section of DNA that is responsible for a characteristic like eye colour or blood group. Humans have around 20,000 genes. DNA makes up genes, which makes up chromosomes. One copy of all your chromosomes is called your genome.



Species
A species is a group of organisms that interbreed to produce fertile offspring. For example, humans are one species and dogs are another species.
Individuals of the same species can reproduce to make more individuals of the same species. Two individuals belonging to different species cannot normally reproduce together. If they do, their offspring is usually infertile and unable to reproduce. Sometimes individuals from two different species can reproduce. For example, animals called ligers are produced when a male lion and a female tiger reproduce, but a liger cannot have offspring. This means that lions and tigers are different species.

Selective Breeding
Selective breeding is when organisms are deliberately bred so their offspring have the desirable characteristics. Pedigree dogs come in lots of different varieties. They may be different colours and sizes, but they are all still dogs. They are all still the same species. The different varieties of dog have been produced through deliberate selective breeding by dog-owners. These are the steps taken to select a particular feature in an organism: choose individuals with the desired feature, let only these individuals reproduce, choose the offspring that have the desired feature, let only these individuals reproduce, repeat steps 3 and 4 until you have produced a variety in which all the individuals show the desired feature

Biodiversity
Biodiversity means having as wide a range of different species in an ecosystem as possible. It is important to conserve the variety of living organisms on Earth. Not only do we have moral and cultural reasons for conserving endangered species, but conservation:

- maintains the future possibility that plant species might be identified for medicines
- keeps damage to food chains and food webs to a minimum
- protects our future food supply

Variation
Variation is the differences between individuals within a species. This can be caused by inherited or environmental factors. Variation can be continuous or discontinuous. All people are human. They belong to the same species. Your friends and classmates may have different eye colour and hair colour. Some will be boys and some will be girls. Some will be tall and some will be shorter. The presence of differences between living things of the same species is called variation.
Variation between different species is usually greater than the variation within a species.

Changes in the environment may leave individuals less well adapted to compete successfully for resources such as food, water and mates. Sometimes an entire species may become unable to compete successfully and reproduce. These problems can lead to extinction. Here are some of the changes in the environment that can cause a species to become extinct:

- a new disease
- a new predator
- a change in the physical environment, such as climate change
- competition from another species that is better adapted, including competition from humans

The dodo was a flightless bird found on the island of Mauritius. It became extinct in the 17th century because of human activities. Humans disturbed the dodo's habitat and also brought new predators to the island, like dogs. The dodo was slow, did not fear humans and was easily caught. It only took about 100 years after its discovery for it to become extinct.

Seed banks are an example of a gene bank. Gene banks are increasingly being used to preserve genetic material for use in the future. A cryobank is another type of gene bank. Embryos, sperm or eggs are stored at very low temperatures in liquid nitrogen (which is at a very chilly –196 °C).

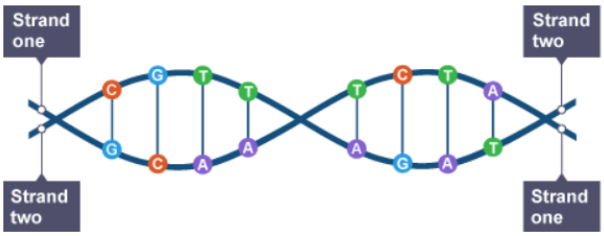
Structure of DNA

Genetic information is passed from one generation to the next. This is called heredity and why we resemble our parents. The genetic information itself is contained in a complex molecule called DNA.

Scientists worked out the structure of DNA in the 1950s. Rosalind Franklin made ‘X-ray diffraction’ images of DNA. James Watson and Francis Crick used information from one of her images to work out a model for the structure of DNA. Work by Maurice Wilkins, a colleague of Franklin, supported their model.

Watson and Crick were able to work out how DNA was arranged and the tiny distances between its different features. They worked out that in a DNA molecule:

- there are two strands
- the strands are twisted around each other to form a double helix
- the strands are held together by bonds between base pairs

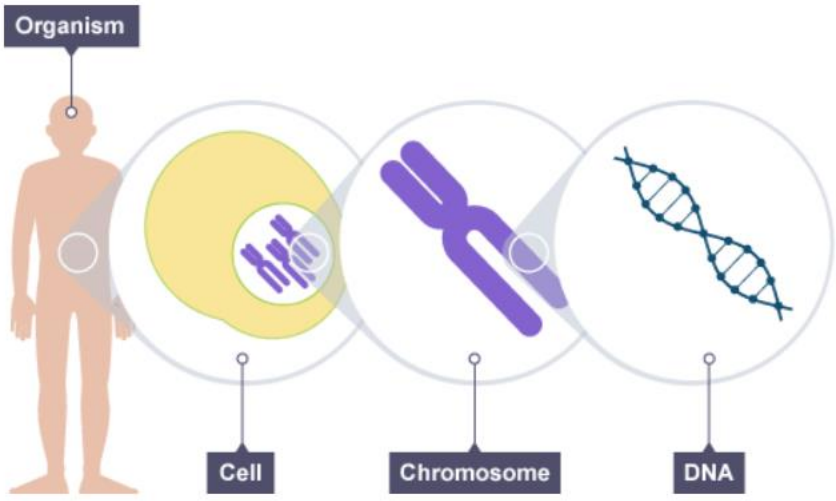


A DNA molecule showing its base pairs, G–C and A–T

Watson, Crick and Wilkins were awarded the 1962 Nobel Prize in Physiology or Medicine for their discovery. Franklin had died before then and so could not be awarded it with them.

Chromosomes, DNA and genes

The DNA in all of your cells is approximately two metres long, except red blood cells which have none and sperm or eggs which only have about one metre. Because it is so long it is very thin and coiled into structures called chromosomes. The chromosomes are found in the nucleus of each cell.



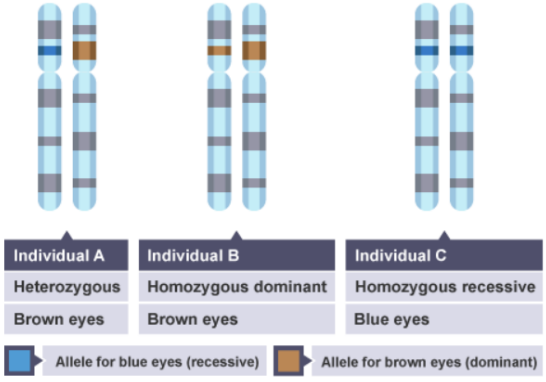
Each cell with a nucleus contains chromosomes, which are made from DNA

Human body cells each contain 23 pairs of chromosomes, half of which are from each parent. So, human gametes (eggs and sperm) each contain 23 chromosomes. When an egg is fertilised by a sperm, it becomes a cell with 23 pairs of chromosomes. This is why children resemble both their parents – half of their chromosomes and DNA come from their mother, and half from their father.

A collection of human chromosomes

A gene is a section of DNA that is responsible for a characteristic like eye colour or blood group. Humans have around 20,000 genes. DNA makes up genes, which makes up chromosomes. One copy of all your chromosomes is called your genome.

- Chromosomes are found in the nucleus of a body cell in pairs. One chromosome is inherited from the mother and one is inherited from the father. The chromosome in each pair carries the same gene in the same location. These genes could be the same, or different versions.
- Alleles are **different versions** of the same gene. For example, the gene for eye colour has an allele for blue eye colour and an allele for brown eye colour. For any gene, a person may have the same two alleles, known as homozygous or two different ones, known as heterozygous.
- The genotype is the collection of alleles that determine characteristics and can be expressed as a phenotype.



Alleles may be either dominant or recessive:

- A dominant **allele** is always expressed, even if one copy is present. Dominant alleles are represented by a capital letter, for example, A. The allele for brown eyes is dominant. You only need **one copy** of this allele to have brown eyes. Two copies will still give you brown eyes.
- A recessive **allele** is only expressed if the individual has two copies and does not have the dominant allele of that gene. Recessive alleles are represented by a lower case letter, for example, a. The allele for blue eyes is recessive. You need **two copies** of this allele to have blue eyes.
- Homozygous alleles are both identical for the same characteristic, for example AA or aa.
- Heterozygous alleles are both different for the same characteristic, for example Aa.

Most characteristics are a result of multiple genes interacting, rather than a single gene.

What is variation?

- The differences in **characteristics** between individuals of the same species is called **variation**.
- Some variation is passed on from parents to offspring, via **genes**, during reproduction. This is **inherited** variation.
- Some variation is the result of differences in the surroundings, or what an individual does. This is called **environmental** variation.

What is variation?

Humans, dogs and goldfish are examples of **species**.

Different species have very different **characteristics** from each other. For example, dogs have tails and humans do not. Dogs have fur, but goldfish have scales.

The individual members of a species also have differences in **characteristics**.

For example, humans have different coloured eyes, and dogs have different length tails.

This means that **no** two members of a species are identical.

The differences between the individuals in a species is called **variation**.

Genetic and environmental variation

Characteristics in an individual are the result of both **genetic** and **environmental** variation.

Environmental variation are characteristics that are caused by the way we lead our life.

Genetics (Hereditary) variation are characteristics that are inherited from our parents.

For example, the weight of a dog depends partly on its genes (inherited) and partly on what it eats (environmental).

The height of a sunflower depends partly on its genes and partly on how much light and water it gets.

Why is variation important?

Variation helps a species to **survive**, by causing individuals of a species to be genetically and physically different.

How does this help?

If all the individuals of a species were genetically identical they would be vulnerable to the same diseases. If this were the case a single disease could wipe out an entire species!

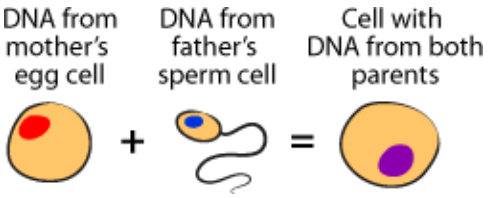
As a result of their genes, some individuals of a species might have better camouflage, or be able to run faster.

These individuals are more likely to survive. This is called the **survival of the fittest**.

The members of a species that survive may reproduce. Their offspring are likely to have the desirable characteristics of their parents. This is how species change in **evolution**.

Activities for this topic

How are characteristics passed onto children from their parents?



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- The _ _ _ from the mother is in the _ _ _ _ _ _ _of the _ _ _ cell.
- The nucleus of the _ _ _ _ _cell contains the father's DNA.
- When the sperm cell _ _ _ _ _ _ _ _ _ _ the egg cell the two nuclei _ _ _ _ and the DNA from both _ _ _ _ _ _ _ will give the instructions for a _ _ _ _.
-

Parents	**fertilises**	**DNA**	**egg**	**nucleus**	**baby**	**sperm**	**join**

Describe some inherited characteristics

Explain how characteristics are passed on using the words dominant and recessive

1) What controls inherited characteristics?
2) What do we call different forms of a gene?
3) List some eye colours.
4) What is meant by dominant?
5) What does recessive mean?
6) Which type of allele always shows its characteristics?
7) Are brown eyes dominant or recessive?
8) If allele T is dominant, what will allele t be?

9) **T** (can roll tongue) is dominant and **t** (cannot roll tongue) is recessive. Describe whether people with the following pairs of alleles and tongue roll or cannot tongue roll.

TT _____ Tt_____ tt_____

Link inherited characteristics to the genes of parents

a) How do we get our eye colour?

b) What are genes made of?

c) Who did we get out genes from?

d) What is the job of DNA?

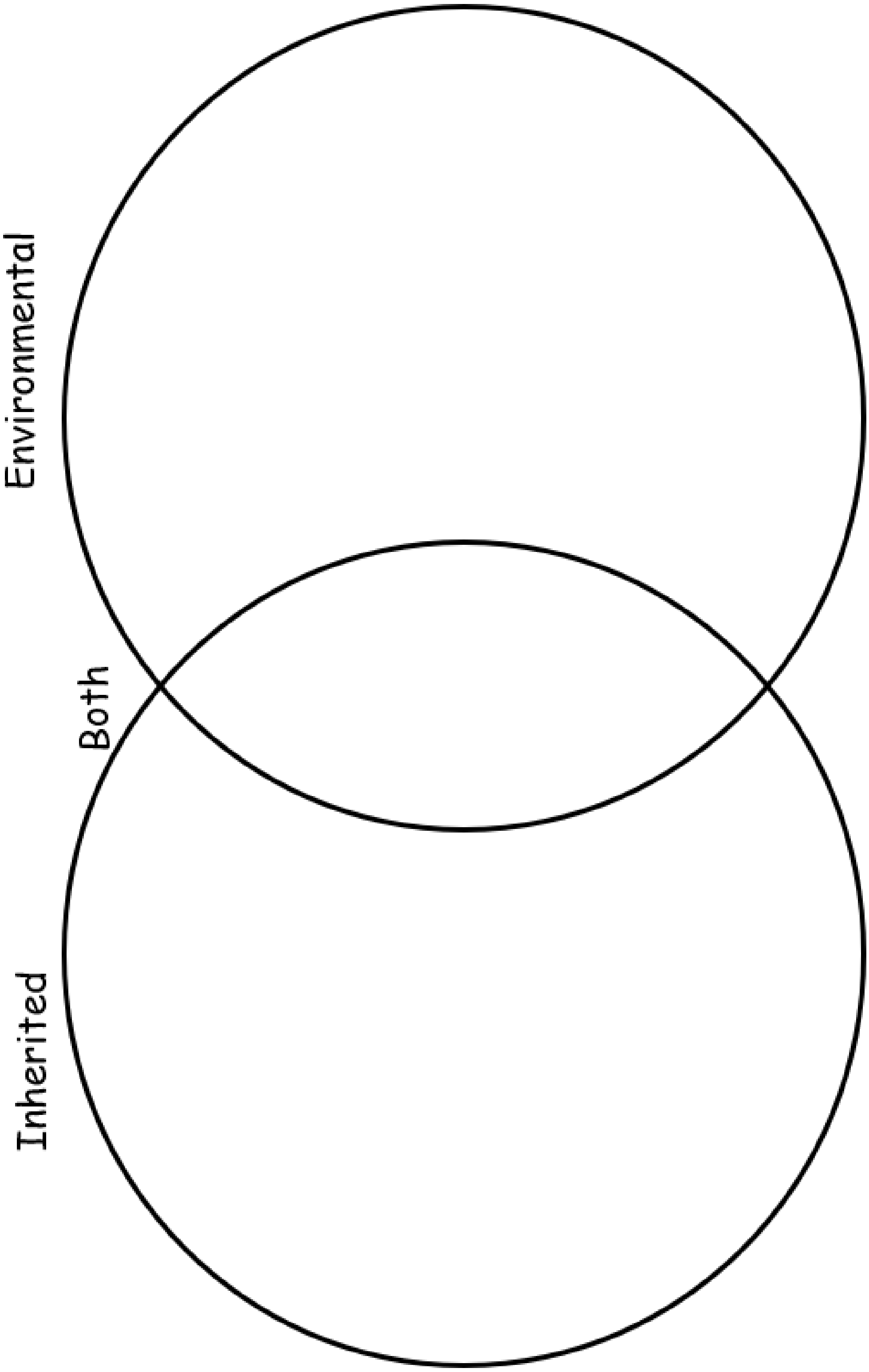
e) Name some things our genes code for?

f) As well as genes, what else can control what we look like?

Tell the full story to explain how the baby mouse inherited all his features

List as many Characteristics as you can for each section on the Venn diagram

Inherited and Environmental Variation



Where are you from?

CHARACTERISTICS
VARIATION
NUCLEUS
CHROMOSOME
DNA
GENE
MUM
DAD
GAMETES
SPERM
EGG
FERTILISED
EMBRYO
MUTATION

B	R	Q	L	X	V	X	M	A	O	X	O	E	J	C
B	F	S	W	D	A	K	Y	R	Q	T	Y	G	G	H
Y	E	I	I	T	R	G	E	N	E	P	T	G	W	A
W	R	F	E	X	I	O	J	R	P	R	Z	X	Z	R
C	T	H	L	K	A	J	Y	A	T	C	S	K	D	A
H	I	N	A	P	T	D	D	L	R	D	P	D	N	C
R	L	W	G	R	I	A	B	J	E	D	E	E	A	T
O	I	N	L	V	O	D	G	S	M	U	M	M	T	E
M	S	T	Q	U	N	O	Y	K	S	W	R	B	E	R
O	E	L	R	D	I	L	Y	A	M	C	V	R	B	I
S	D	T	P	K	B	F	U	W	G	Q	X	Y	D	S
O	U	N	U	C	L	E	U	S	H	W	M	O	Q	T
M	D	E	E	L	A	P	S	P	E	R	M	N	Q	I
E	R	A	V	S	O	G	A	M	E	T	E	S	L	C
J	E	M	U	T	A	T	I	O	N	X	S	Z	A	S

You may need a parent to help you with this activity

You can watch this video to help you if you get stuck
https://www.youtube.com/watch?v=Mehz7tCxjSE

Dragon Genetics

- For this activity you will all be dragons.
- Each of your 4 chromosomes has 1 gene coding for a certain characteristic.
- Each gene has 2 alleles.

Allele Key

Red chromosome –	**W = wings**	**w = no wings**
Yellow chromosome -	**F = not fire breathing**	**f = fire breathing**
Green chromosome -	**G = green eyes**	**g = yellow eyes**
Blue chromosome -	**R = red body**	**r = purple body**

- You will need to design two dragons (parent dragons) using the information above and work out the allele combinations each of your dragons have, then draw what your parent dragon's are going to looks like.
- You are then going to on several scrap pieces of paper you are going to write Red Chromosome on one side and then W or w on the other (dependent on what your parent dragons look like if both of your dragons have wings you will have two W cards), and continue this for each chromosome on the list.
- You are then going to place the cards with colour side up (mix them up) and the pick a card from each colour.
- You will then have your four characteristics to create your baby dragon.
-

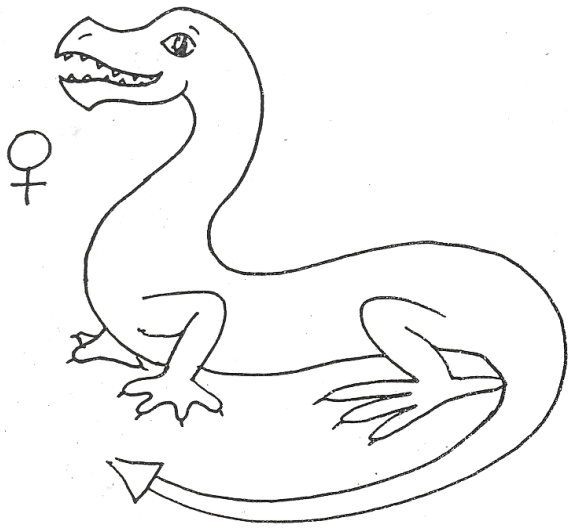
If you are feeling brave and adventurous, you could add in other characteristics and alleles such as …

Purple chromosome –	J = yellow spots	j= yellow stripes
Brown chromosome -	P= Spikes	p= no spikes

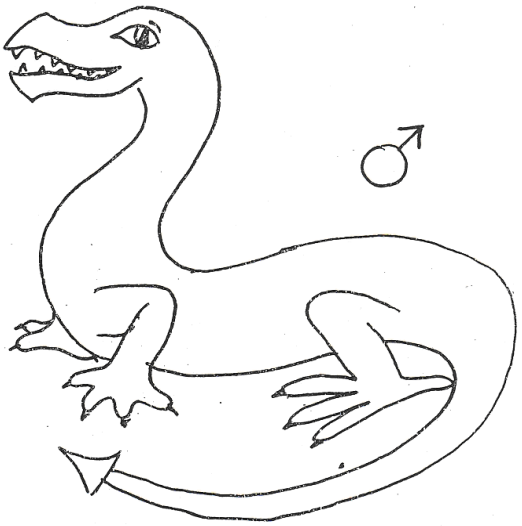
Have fun and good luck, I look forward to seeing your dragons soon.

If you are struggling to understand how to do this task properly, you can simply design two dragons and pick characteristics from each to create a baby dragon.

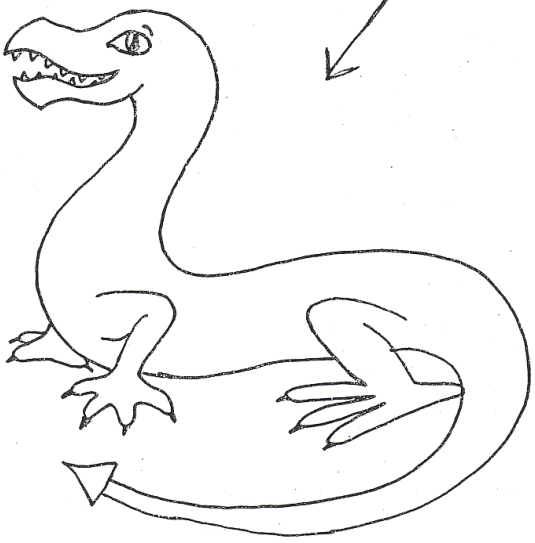
DRAGON GENETICS



Chromosome	Allele combination
Red	
Yellow	
Green	
Blue	



Chromosome	Allele combination
Red	
Yellow	
Green	
Blue	



Chromosome	Allele combination
Red	
Yellow	
Green	
Blue	

Task 2

Draw lines to match up the beginning and the end of the sentences relating to chromosomes, genes and DNA.

DNA is short for ...	... called a double helix.
Chromosomes contain many genes that ...	... deoxyribonucleic acid.
Genetic material is found...	... 4 DNA bases.
There are 23 pairs ...	... controlled by genes.
DNA is a molecule made up of a combination of ...	... of a chromosome.
We inherit our genes ...	... code for our characteristics.
Each gene is a short section ...	... long coiled chains of DNA.
Chromosomes are made up of ...	... of chromosomes in the nucleus of a body cell.
DNA has a special structure ...	... in the nucleus of each cell.
Our characteristics are ...	... from our parents.