Hello. I'm Dr Alex Lathbridge and this is Bitesize Biology.

This is episode two of a seven-part series on Inheritance, variation and evolution. In this episode we're going to talk about genetic inheritance. That means we're talking about chromosomes, genes and alleles.

So do you remember that cells have a nucleus? If not, go back and listen to our series on The Cell.

Here's a quick recap: The nucleus is sort of like a library, containing lots of books, or chromosomes.

Within the books there are lots of recipes, or genes, that have instructions, and the recipes are written with letters, known as bases. This is the DNA code.

Each gene, or recipe, codes for a sequence of amino acids, which code for a specific protein. Lots of coding there I know. Now, those genes, the instructions, they determine what characteristics you inherit. Often, characteristics are determined by several genes interacting with each other. But there are a few examples where characteristics are controlled by just one gene, like eye colour in humans.

But before we get into that, I'm going to take you through the key terms you need to know, so grab a pen and write this down: Chromosomes are contained inside the nucleus of a cell and contain lots of different genes. Chromosomes are found in the nucleus as pairs, one is inherited from each biological parent.

DNA is found in our genes and everyone's DNA is completely unique to them. It is the basic genetic material inherited from our biological parents and determines our characteristics.

Genes are sections of DNA. And alleles are different versions of the same gene. They exist as pairs.

Now we've not talked about alleles before, but they are really important. Why?

You get half your genes from each biological parent. For almost every gene you get one allele from each parent.

So if a gene is a recipe in a book, the alleles are the variations. The recipe from your mum might say use blue icing and the one from your dad might say use red icing. The same gene (which is icing) but different variations, red or blue.

Real world example that isn't to do with cake: we all have different eye colours. Some of us might have brown eyes, green eyes or blue eyes. These different versions of the same gene for eye colour, these are the alleles.

You inherited two alleles for eye colour and the cell chooses which one to use.

I'm going to say this word "allele" a lot in this episode so be sure to get your head around it before we go any further.

I am sorry because I'm going to keep throwing some more terminology at you. You really need to have that pen in hand.

Dominant alleles. These the alleles that are always used by the cell. No matter what characteristic they cause and no matter what other allele is paired with it, they will always be chosen by the cell. Even if there is only one dominant allele in the pair. Dominant alleles are written as big capital letters, so if its dominant make sure you give it a capital letter. The alleles for brown eyes are dominant.

The opposite of that: recessive alleles. They won't be chosen by the cell in the presence of a dominant allele. A characteristic caused by a recessive allele will only be chosen if the individual has two recessive alleles, one from each biological parent, and does not have a dominant allele. These are written in non-capital letters. The allele, for instance, for blue eyes is recessive, so if you have blue eyes, that means you've had to inherit two recessive alleles on the eye colour gene from each of your parents.

We've got homozygous alleles. Those are two alleles that are both identical for the same characteristic. An organism might have two alleles from their mother and father for a particular trait, eye colour for example, that are the same, so if you receive this allele for brown eyes from each parent you will definitely have brown eyes.

And then we have heterozygous alleles, these are the opposite of homozygous alleles, these are two alleles that are different for a characteristic. An allele for blue eyes from one parent, and brown eyes from the other. And no this doesn't mean that the person will have two differently coloured eyes.

It's easier to remember these two long words if you think that homo means same, and hetero means different, homozygous, heterozygous.

A genotype is the combination of all the alleles that an individual has. So in effect, it's their genes.

Genotype = genes. It's everything.

A phenotype is the characteristics that an individual has, as a result of their genes.

So phenotype = physical.

So, you might have a genotype containing two recessive alleles for eye colour, and the phenotype would be your blue eyes. Or two dominant alleles (like brown) and your phenotype would be brown eyes.

But you could also have a phenotype, so physical characteristic, of brown eyes with a heterozygous genotype (so that would be one blue allele and one brown allele) you wouldn't be able to tell the difference just by looking at someone's face.

So two people with brown eyes, one of them could have homozygous alleles, they might have two dominant alleles for brown eyes. Whereas someone else could have heterozygous alleles, they could have inherited one allele from one parent for recessive brown eyes, versus one from another parent for dominant brown eyes.

Just quickly I want to give you two examples of inherited health disorders: Cystic fibrosis is an inherited disorder that affects the lungs and digestive system. It is caused by a recessive allele. So to be born with cystic fibrosis, the offspring inherits two copies of this faulty recessive allele, one from each of their parents.

And also Polydactyly is an inherited condition where a person has extra fingers or toes and it's caused by a dominant allele. So it can be passed on by just one allele from one parent.

Genes also play a role in determining the biological sex of offspring. This is called sex determination.

Typically, but not always, people have 23 chromosomes pairs. For example, people with Down's Syndrome have an extra copy of chromosome 21.

The first 22 are for characteristics, things like eye colour, and the 23rd pair is for biological sex: whether offspring are male or female.

Because during fertilisation, there is a 50% chance that a sperm containing an X chromosome will fuse with the egg (an egg is always X); this would result in a baby girl, XX.

There is also a 50% chance that that sperm could be containing a Y chromosome. And that will fuse with the egg; this would result in a baby boy, XY.

Because this is GCSE-level, all of that is a huge simplification on biological sex but it's what you need for the exams.

(In actual scientific fact, sex differentiation beyond the rigid XY = male and XX = female – there's some diversity in the middle. You can have XY chromosomes but appear female. Or XX chromosomes but have male physical characteristics.

Basically, what I'm saying is that while the sex chromosomes are very important parts, human development is a complex web of genetics, hormones, and lots of different biological factors that biologists are still discovering today.)

And remember, sex and gender are fundamentally different. Even though we use the same words (male and female), gender is more about perception and society, not about cells.

I'm Dr Alex Lathbridge and this is Bitesize Biology.

Catch up with the rest of the series on BBC Sounds.