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

This is the last episode in our nine-part series about the cell.

And well done us because we've gone through the structure of the cell, how cells specialise to do different jobs, how cells make proteins, and how cells control what goes in and out, and how DNA are the instructions for life.

But there's one more cellular process that you need to know about: respiration.

First, we're going to start with what respiration isn't.

Respiration isn't about cells breathing, I know it sounds like it, but in this case, it isn't.

It is about how living things get their energy from food. Respiration is how the energy is transferred by breaking down the sugars, so your cells can use the energy stored in there. You'll need to remember the two different types of respiration with similar names:

aerobic and anaerobic respiration – with oxygen and without oxygen.

So grab a pen and write this down:

Your cells need energy for all of the things they need to do to keep you alive, for movement, growth and repair.

Warm blooded creatures like you and me, need it to keep their blood warm.

When we eat carbohydrates, our body breaks it down into simple sugars. There are many sugars but the one you need to remember is glucose.

Your cells need the energy provided by glucose, but you can't just pour syrup on your cells like they're microscopic pancakes.

The cells need to turn it into something that the body can use.

All cells do cellular respiration because all cells need energy, and they've got two different ways of

doing it, both of which take place in the cytoplasm and mitochondria of the cell.

Cytoplasm is where the chemical reactions take place in the cell.

Mitochondria is where cells release the energy they need and where respiration takes place (you see why I called it the battery of the cell in previous episodes, yeah?)

Grab a pen, and let's go.

The first one we're going to chat about is aerobic respiration:

This is where the cell takes the glucose and it reacts with oxygen (which is where "aero" in the name comes from).

This releases the energy so the cells can use it.

There are also some waste products made, things that aren't needed by the cell.

These are carbon dioxide and water, eventually expelled by the body.

There's an equation, or formula, that you are going to need to remember (so please write this down):

glucose + oxygen → carbon dioxide + water and energy released

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Now if that sounds familiar, it's because when we go back to the photosynthesis episode, the photosynthesis equation is just this one backwards.

If you need some help remembering this, this might not work for you, but I remember it as 121 666.

Let me explain:

There are six oxygen molecules going in ($6O_2$) and six carbon dioxide and six water molecules coming out on the other side ($6CO_2$ and $6H_2O$).

Then just try to remember that glucose has six carbons, twelve hydrogens, and six oxygens (so if you divide by six – that's one, a two and a one.)

glucose + oxygen → carbon dioxide + water and energy released

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Now remember when we say converted in equations you show that with a right-handed arrow, check out the Bitesize website and you can see that equation.

Don't forget that plant cells respiration too. They can respire in the light and in the dark.

So most respiration needs oxygen, but not all, and this is where the second type comes in: anaerobic respiration.

Imagine that you're going for a run, you're really, really pushing yourself. You're working your muscles hard, and they need energy quickly. You are breathing in and out, but you can't get the oxygen to your muscles fast enough, but you need to keep going and your muscles start to ache, they start to burn.

This is because your muscles are using anaerobic respiration.

Anaerobic respiration not ideal because it's not very efficient at all.

It initially releases nineteen times less energy than aerobic respiration, but you can do it for short periods of time if you need to – if you need to finish that run.

And that ache in your muscles is because anaerobic respiration makes lactic acid.

This lactic acid builds up, and your body is not a fan of it, and this is why your muscles start to hurt.

Now your body has to get rid of that lactic acid, so it's taken to the liver by your blood where it's mixed with oxygen to turn into carbon dioxide and water, this releases the rest of the energy, or it's converted to glucose.

Both these methods of getting rid of lactic acid require oxygen, it's why you keep breathing really heavily after exercise.

While you don't need oxygen to release energy in anaerobic respiration, you do need oxygen to get rid of the lactic acid it makes.

So in anaerobic respiration glucose is turned into lactic acid, which releases energy.

It's not just animals that do this, there is also a useful single celled organism called yeast that uses anaerobic respiration. We use yeast to make bread or alcoholic drinks like wine or beer.

Yeast reproduces rapidly, using up all the oxygen so it switches to anaerobic respiration which also makes ethanol and carbon dioxide. So, ethanol (alcohol) is a by-product of anaerobic respiration.

Let's take a moment to compare them:

Aerobic respiration uses oxygen.

Anaerobic respiration can happen without it.

In aerobic respiration the oxidation of glucose is complete.

In anaerobic respiration it's incomplete, this means that there's extra stuff that it makes still containing energy.

So aerobic respiration makes carbon dioxide and water, and those things don't have available energy, but anaerobic respiration makes lactic acid in humans and animals. In yeast it makes ethanol and carbon dioxide. These things still have some energy in them, so it's not a very efficient process.

Aerobic respiration releases quite a lot of energy and anaerobic respiration only gives a small amount, but it happens very quickly, ideal if you are running away from something that wants to eat you.

One final thing you need to remember is that respiration is exothermic, this means that energy is released to the surroundings.

I'm Dr Alex Lathbridge and this is Bitesize Biology. You can listen to the rest of this series, and all the other topics that we're covering on BBC Sounds.