# BBC Bitesize – Physics

# Episode 6 - Conservation and dissipation of energy

**ELLIE:** Hello and welcome to the BBC Bitesize Physics podcast.

**JAMES:** The series designed to help you tackle your GCSE in Physics and combined science. I'm James Stewart, I'm a climate science expert and TV presenter.

**ELLIE:** And I'm Ellie Hurer, a bioscience PhD researcher.

**JAMES:** And today we're going to be talking about the conservation and dissipation of energy and how to calculate it.

**ELLIE:** We started talking about energy transfers back in episode one of the series, so if you want to get a fuller picture, I'd recommend going back and listening to that first. But if you already have, let's begin!

**JAMES:** Ellie, there is one fundamental idea you need to know when it comes to energy. We've mentioned it a few times in this series and in other episodes of the podcast.

So, can you finish the sentence for me? Energy cannot be created...

**ELLIE:** Or destroyed – energy be transferred usefully, stored or dissipated. And just as a reminder, ‘dissipated’ means it is wasted, usually by being lost to the surroundings.

**JAMES:** Yeah, that statement that energy cannot be created or destroyed has a name. It's called the law of conservation of energy. So that means when you toast a slice of bread, for example, and transfer the electric energy store into the thermal energy store of the heating element inside the toaster, that energy isn't being created or destroyed, it's just being transferred.

**ELLIE:** But how does that energy transfer change when it happens in a closed system like a slow cooker?

**JAMES:** Well in a closed system, energy is only transferred within that system. So while the electric energy of the plug is transferred into the thermal energy store of the slow cooker, there is no net change to the total energy of the whole system.

**ELLIE:** But even though there is no net change in the total energy, some of the energy is transferred in a non-useful way. For example, in heating the casing of the cooker rather than the food inside it.

**JAMES:** Have you ever been doing homework on a laptop and then suddenly it feels like your laptop is getting too hot? Put your clothes in the washing machine and gotten distracted by just how much noise it's making?

**ELLIE:** Well, that's because in all system changes, some energy is dissipated, which means it's wasted. When energy is transferred, some of it is stored in less useful ways. So let's talk through a few examples.

**JAMES:** When you drive a car, you convert some of the energy in the chemical energy store of the fuel into the kinetic energy store of the car, which is why it moves. But, some of that energy is dissipated. Any ideas how? I'll give you a few moments to think about that one.

One of the ways energy is dissipated in a car is through the way a car also transfers energy to the thermal energy store of the air particles in the surroundings, through the engine and the gas that comes out of the exhaust.

**ELLIE:** When you use a blender to make a smoothie, you transfer energy from the electrical energy store into the kinetic energy store of the blades of the blender. But some of that energy is dissipated here too. Can you guess how? I'll give you a few moments to think.

So, in a blender, some of that energy is dissipated because the blender converts some of that energy into sound waves.

**JAMES:** It does a very good job because blenders are so loud.

**ELLIE:** So loud.

**JAMES:** Unnecessarily so.

**ELLIE:** Yeah.

**JAMES:** And one final example, when you start a fire with wood to keep you warm, like on a cold winter's day, you transfer energy from the chemical energy store of that wood into the thermal energy store. But some of that energy is dissipated because it becomes light energy which you might not need if you were starting the fire in the middle of the day, for example.

**ELLIE:** So a lot of that energy is wasted during energy transfers, but does it have to be that way?

**JAMES:** Well, we can reduce the amount of energy wasted is the good news. So as the world becomes more environmentally friendly, people are always coming up with more energy efficient ways of building things. Especially when it comes to dissipated thermal energy. For example, an energy efficient light bulb is great.

**ELLIE:** When you switch on a light bulb, it gives you light energy. However, in the past, if you were to touch a bulb, which I really don't recommend you do, the old-fashioned bulbs used to get very, very hot.

**JAMES:** But that thermal energy is wasted because you don't need your light bulb to warm up the room. So inventors have created energy efficient light bulbs that transfer more of the energy usefully, so less energy is wasted as heat to the surroundings.

**ELLIE:** The higher the thermal conductivity of a material, the higher the rate of energy transfer by conduction across the material. So, the better a material is at conducting heat, the more energy that is transferred across it.

**JAMES:** Yeah, a laptop is a really good example of this. So, let's say you're working on a school project and you're using loads of tabs and different apps to do that. The laptop is going to get hotter. This is waste thermal energy. And some of the components inside are made of metal, which more easily conduct heat, so more heat energy is lost through them. And even though your laptop doesn't need to be hot to work, it is still heating up.

But knowing that fact, that the higher the thermal conductivity of a material the higher the rate of energy transfer by conduction, can help us create more energy efficient buildings.

**ELLIE:** We've got to insulate a building with materials that have a low thermal conductivity.

**JAMES:** So Ellie, if you could build your dream house, what materials would you use to build it?

**ELLIE:** Hmm, probably a combination of things like bricks, glass and wood. You know, like, most buildings are made of.

**JAMES:** Yeah, they are. And for a very specific reason, to manage different temperatures. So, no matter where Ellie's dream house is built, it can handle it. If you were to build a house with copper walls, it would get very, very hot in the summer and incredibly cold in the winter. Because copper has a high thermal conductivity.

**ELLIE:** And that's why we build houses with materials like brick and wood. Because they are poor thermal conductors. And the thicker the material used, the less heat that will be conducted through it.

**JAMES:** And some houses even have layers of fibre between the bricks called cavity wall insulation to insulate them even more. That way the walls of the house keep heat in and stop it from being able to conduct through the walls as easily.

**ELLIE:** So, when it comes to energy transfers, there are lots of ways we can build buildings and products to make them more energy efficient and reduce the amount of waste they release into the environment.

**JAMES:** But if you want to learn more about insulation and the different ways it's being used to insulate buildings and other structures, head to the BBC Bitesize page to learn more.

**ELLIE:** But before we go, let me recap the three key takeaways we heard today. So, the first key point is: energy can be transferred usefully, stored or dissipated, but it cannot be created or destroyed.

And in all system changes, energy is dissipated so that it is stored in less useful ways. This energy is often described as being wasted.

And finally, the higher the thermal conductivity of a material, the higher the rate of energy transfer by conduction across the material. Okay, so now you understand the basics of conservation and dissipation of energy. In the next episode of Bitesize Physics, we're going to explore efficiency and how to calculate it.

**JAMES:** Thank you for listening to Bitesize Physics. If you found this helpful, please go back and listen again. And of course, make some notes as you go along and always come back here whenever you need to revise.

**BOTH:** Bye!