BBC Bitesize – Physics

Episode 4 – Specific heat capacity practical

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. Before you listen, just a reminder that you can listen to the whole series or find an episode that you want to focus on. Whatever works for you.

JAMES: Okay, let's get started. Today we're going to be talking about the specific heat capacity practical. So Ellie, you might be wondering why we're wearing lab coats today.

ELLIE: Yeah, I was a little bit confused when I saw your text saying we needed lab coats, safety goggles and a clipboard to record a podcast. It's not exactly a dangerous activity.

JAMES: It's a serious job, Ellie. You never know when a microphone might jump at you, a script might give you a paper cut or a listener might leave a mean comment because, well, they don't like our jokes.

ELLIE: Our jokes are great, so that's not going to happen.

JAMES: Ha, ha, ha. Look, we're off topic. The reason we're in lab coats today is that part of GCSE physics includes a practical activity all about specific heat capacity. Finally, a practical.

If you haven't listened to that episode about specific heat capacity, please do pause, go back and listen and then return to this episode and come back and do it with us. As a quick reminder, specific heat capacity is the amount of energy required to raise the temperature of one kilogram of a substance by one degree Celsius.

ELLIE: And when it comes to your GCSE, you'll carry out a practical investigation to determine the specific heat capacity of one or more materials. Let's try an example.

JAMES: As a heads up, we're gonna go through quite a few definitions and steps you'll need to understand for this practical. So, classic us, if you haven't already, get your pen, get your paper and let's do it together.

So in this practical, the aim of the experiment is to find out the specific heat capacity of a sample of material.

ELLIE: The independent variable is the material the block is made from. In this case, you'll use an aluminium block that will have two holes drilled into the top that don't go the whole way through.

JAMES: The dependent variable is the specific heat capacity value, and the control variables are the time the heater is on for and the mass of the material used.

ELLIE: Okay, so let's walk through how you would do the experiment step-by-step. So step one, unless you know your block is exactly one kilogram, measure the mass of the block using a balance.

JAMES: Step two, place the immersion heater into the central hole at the top of that aluminium block.

Step three, place the thermometer into the smaller hole of the block and put a couple of drops of oil into it just to make sure the thermometer is surrounded by hot material.

ELLIE: And step four, fully insulate the aluminium block by wrapping it loosely with cotton wool.

And step five, record the starting temperature of the block.

JAMES: Yeah, so far so good. Step six, connect the heater to the power supply and of course don't forget to turn the power supply on. Time it for 10 minutes and then turn the power supply off again. There also needs to be an ammeter in the circuit so the current can be measured.

And then finally, step 7, after 10 minutes the temperature will still rise, even though the heat has been turned off, and then it will begin to cool. So, record the highest temperature that it reaches and calculate the temperature rise during the experiment.

ELLIE: And as you do the practical, you'll need to measure four key things. The current reading from the ammeter, the voltage reading from the power supply, the initial temperature in degrees Celsius, and then the final temperature also in degrees Celsius.

JAMES: And when you do this practical in class, you'll then take your measurements and analyse them to calculate the specific heat capacity of the block of metal you used.

ELLIE: And to learn more about the equation you need to use to calculate this, head over to the Bitesize website to read more.

JAMES: Then repeat the whole method with another material, as that is the independent variable being investigated.

ELLIE: Always remember that no experiment is perfect. Sometimes we run into something called an experimental error, which is when our results aren't completely accurate because of other variables. So, can you think of any we might find in this experiment?

JAMES: Well, one variable could be that not all of the heat from the immersion heater will actually heat the aluminium block. Some will be lost to the surroundings.

ELLIE: Exactly, James. That means that more thermal energy is transferred than is necessary for the aluminium block alone, because some of the energy is transferred to the surroundings.

JAMES: Which means the final result of our specific heat capacity will be higher than what is actually needed for one kilogram of aluminium alone. So, it's really important to know that other variables will affect your practical.

ELLIE: Because this is a practical experiment, there are some things we need to do to make sure the experiment is safe and that the results are accurate.

JAMES: Yeah, in this experiment we're working with an immersion heater, which can get very hot very quickly, which of course is a hazard, it can burn our skin. So, what measures Ellie, should we take to control that hazard?

ELLIE: Well, firstly, you wouldn't touch the heater when it's on. You would also position the apparatus away from the edge of your bench to reduce the risk of it falling. As well as that, once you're done with it, you would give the heater time to cool down before packing it away. Sometimes you'll be given a method that isn't quite right and the exam will ask you to suggest how to improve it. In that case, you should compare the method in the exam to the one you've learned and see what's different.

JAMES: For example, they may give you a step-by-step method that doesn't mention insulating the block. In that case, the improvement will be to insulate the block to minimise the loss of energy in the surroundings.

ELLIE: So, here are some key things you need to remember. The aim of the experiment is to find out the specific heat capacity of a sample of material.

Two, during the practical, you need to record the temperature change, current and mass of the aluminium block.

And finally, one of the potential hazards of this practical is accidentally burning yourself. You can avoid this by not touching the heater when it's on and positioning the apparatus away from the edge of your bench.

JAMES: You'll learn more about this practical when you're in the class, but be sure to pay attention and make notes on everything that we mentioned here when it comes to practicing that experiment.

ELLIE: And, again, don't forget to stay safe and never touch a heater when in use.

So those are some of the key things you need to know for your practical investigation. In the next episode, we're going to be talking about power, so stay tuned.

JAMES: You sound like you're excited about that one.

ELLIE: Yeah. Woo!

JAMES: Thank you for listening to Bitesize Physics. As always, if you found this helpful, you can of course go back and listen again, make some notes along the way and come back here whenever you want to revise.

ELLIE: There's also so many resources available on the BBC Bitesize website, so be sure to check it out.

BOTH: Bye!