



Solving Crimes with the Necrobiome

Ed Yong: Most of us think of death as the end. But for the multitudes of microbes in our bodies, death is actually a new beginning.

Jessica Metcalf: Death is a major event for microbes. Um, because, then the environment in and on your body changes.

Ed Yong: That's Jessica Metcalf – she's a microbiome scientist at Colorado State University.

Jessica Metcalf: If you're interested in studying what happens after death, you really have to include the microbes. They're such an incredibly important component of these processes that happen after death.

Ed Yong: Right, because in death, as in life, microbes are all around us... From the moment we're born, each of us is in an active partnership with our microbiomes –one that's affected by everything from our environment to what we eat, and death is the final event in that partnership, and it triggers massive changes.

[music playing]

[bell tolling]

Jessica Metcalf: Once a person dies, the microbes that are going to do the decomposition start to grow and become abundant. This change is actually very consistent across different people. The microbes that start to become abundant after I die are very similar to the microbes that will become abundant after you die.

Ed Yong: And how does that decomposition process work? How does our body transform into being part of the earth again?

Jessica Metcalf: There's sort of five basic stages that the body goes through after death. First is fresh, death has just happened and really visibly the condition of the body doesn't really look different yet. But this is really where everything is starting.

The immune system shuts down. Suddenly, all these microorganisms that have been living in and on your body are no longer sort of under control. Those microorganisms are able to take advantage of, um, you know, this immune-free environment, uh, and sort of go bonkers.

Jessica Metcalf: These microbes begin to consume the nutrients that are becoming available now in this corpse. They start to grow and they're creating gases, and those gases are pushing up the skin, and you get bloat.

Ed Yong: Wait, so the microbes that were helping us to digest our food are now digesting us?

Jessica Metcalf: Right, it's a little depressing, but it's cool.

Ed Yong: Ok, and now what happens?

Jessica Metcalf: Fluids that are really rich with different nutrients start being released through say the nose or the anus ...

Ed Yong: Lovely.

Jessica Metcalf: And at some point, you get a rupture. Once rupture happens, that's really a game changer because things really start to speed up. *[music playing]* Microbes from the environment, whether they were on your skin or in the air, or they are brought by an insect or from the soil, now all can access the inside of the body.

Jessica Metcalf: This is sort of where you start active decay ...

Ed Yong: I thought we were in the active bit already.

Jessica Metcalf: ... with, uh, you know, sort of the flesh starting to be consumed. And as, uh, that transitions into advanced decay, you start to see sort of the caving of flesh because it's lost so much of the liquid.

Ed Yong: Where does it all end?

Jessica Metcalf: So dry remains. This is where the body is becoming a skeleton.

Ed Yong: And all of this. Does it happen to all of us in the same way?

Jessica Metcalf: The change is so consistent that we can build a clock that really is at an accuracy level that is going to be very useful to criminal investigations.

[siren]

Ed Yong: Why would it be useful for criminal investigators? What sort of questions would it help to answer?

Jessica Metcalf: What is the post-mortem interval? What is that interval since death? Criminal investigators want to use that to, so, validate alibis, for example.

Ed Yong: So you are saying that the pace of these microbial changes is precise enough that eventually it could be used as evidence?

Jessica Metcalf: It actually is like a clock.

Ed Yong: But surely this whole process of decomposition goes faster on hot days?

Jessica Metcalf: Yeah, so, what we do is we use a temperature-based scale, because the temperature, as you can imagine, affects how quickly this decomposition in this microbially driven process is happening.

Ed Yong: So... how do you actually measure this? It's not like you can actually be there at the moment people die.

Jessica Metcalf: We use anthropological research facilities. These are facilities where people can choose to donate their body to be part of a forensic experiment after death.

We're interested in what happens? How does it decompose? We sample the skin with a swab and the soil with a swab; for example every day, for some number of days. And then we sequence the DNA from the microbes that we have on those swabs so we know what microbes should be there at a particular time point.

By doing that across a lot of different time points, that helps us sort of build this picture so that when we have an unknown sample we can say, "Oh it matches this one time point here."

Jessica Metcalf: What we found with our human decomposition experiments is that we could accurately estimate the time since death within about two to four days over twenty-five days.

Ed Yong: And what happens if you find like just a pile of bones? Is it too late to get any meaningful information out of that?

Jessica Metcalf: As you move further away from death, you really don't have many tools available. And so what we're trying to do is say, "Okay, are there some slower processes that microbes are involved in, such as the decomposition of bone, that could be useful for these bodies that have been dead for a long time?"

Ed Yong: It seems like law enforcement agencies would be really interested in that.

Jessica Metcalf: In fact our research is funded by the Department of Justice.

Ed Yong: I guess the point here is that death isn't really an end. Death, paradoxically, turns out to be teeming with life.

Jessica Metcalf: Death is really just, it's the beginning of new life for a whole set of organisms from ones we can't see all the way to the ones we can see. Once a person dies, the recycling begins.

Ed Yong: Maybe when I die I will become ... tree food ...

Jessica Metcalf: You're going to become something.

Ed Yong: Thanks, Jessica – I look forward to the day when finally I can be of service.

Ed Yong: If you couldn't get enough of microbe-ridden corpses, then click on some of the articles linked to below which take a deep dive into decomposition. And in the meantime, keep leaving your great questions. We'll be answering more of them in another video in a couple of weeks.

END OF EPISODE