There are so many processes that are thermally activated. There are so many processes that have Arrhenius-like behavior. That are Arrhenius-like. And if you go to Dartmouth then they'll give you goodie bags with live crickets. And actually I really hope not. But this is one of the labs that they have where they take crickets and they measure the number of times a cricket chirps. And they're like, well okay. Let's measure the cricket chirp over 13 seconds. We're gonna cool them down, hopefully not too cold, and then we're going to heat them up, hopefully not too hot. Because crickets are nice, right? And so then-- and they ca-- but look at that. And they count it. And then what do they do? Well they didn't know about Arrhenius yet until somebody from MIT went and visited. So the first thing they did is they plotted the data. Look at that. Chirps per 13 seconds plotted. And they're all sitting there trying to fit a straight line to it. And then someone from this class is up there visiting. They're like, you know what i think, this looks like a thermally activated process. So i think it's probably exponential. And then they fit this nice exponential and it fits the the cricket tripping beautifully. And you can go even further because you see if you got this far. Well now you see this is a line. This is a line and we're going to do that a lot when we go into reaction kinetics. If you have a exponential and you take a log, that's a line versus 1 over T. Right? That's a line versus 1 over T. And so that's another way you could look at data. They didn't do it there. But, you know, you could plot for example-- you could plot 1 over T versus the log of the number of vacancies. But the lattice-- the number of vacancies is what we want. That ratio is the concentration. That concentration is in equilibrium at some temperature. Okay. The lattice-- the number of lattice sites is simply how many lattice sites you have, in whatever volume you have, for whatever crystal structure you have, for whatever element you have. We'll see that in a few examples. So that's just a concert-- it's the number of sites you have in the chunk of material. And then instead of-- The question this equation tells you the answer to, is how many of those have a vacancy? Because it's a thermally activated process. And if you plot that log in Nv versus temperature you get this really nice linear line. And the slope of that line is equal to minus E vacancy divided by R or it could be kB. R. Let's write this again per mole.

Or it could be kB if it's per atom. You will see both. You will see both. And this intercept-- intercept-- is equal to the-- let's see-- the intercept is equal-- what do i have here? The log of n. Did i write it right? Log of n.

Okay. Alright.

Now, okay. Oh yeah. What else can you do? Well before we go on to the defects, this explains the doping. I kept calling the doping in semiconductors a thermally activated process. But look at what happens. This is the carrier concentration in that conduction band. The thing you've been you've been learning about, right? And thinking about. But look at it now versus temperature. It's a straight line. It's a straight line. This is-- this is experimentally what you observe. And the reason is because it's a thermally activated process. And in fact, in this case, what is the activation energy? Right? The activation energy for getting an electron into the conduction band is the gap. Right? And so now you say germanium has a smaller gap than silicon, which has a smaller gap than gallium arsenide. The slopes are different. The slopes are different because the energy that it takes in that activated process is the gap. That's why the slopes are different. Right? Okay. Alright.