Why does this matter?

We go back to the pteropod.

And by the way, I didn't have this link, and I should have when I showed you the-- and this is your goody bag, et cetera.

There's some really nice articles here that you can find related to these experiments and other things about ocean acidity in case you're interested.

But see, what I did was that this was my why this matters on Monday.

And I wanted to tell you about the goody bag and about how things dissolve, because Monday was about dissolving and finding a saturation point.

Now we can get to the next place, which is, why does that matter for the pteropod's shell?

What is the chemistry that matters there?

OK, so I made the ocean a little more acidic.

Why does that matter?

But you see, now we're armed with the knowledge we need to answer that question.

Now we're armed with it.

All we need to do, as always with everything in life, is look at the chemistry.

That's it.

Say that at the Thanksgiving table.

You'll be very popular.

We said CO2 plus H2O.

This goes-- oh, find some equilibrium to H2CO3.

Now, this is called carbonic acid.

This is called carbonic acid.

There's the pteropod up there.

And there's the reaction that's really relevant that you'll see from the ones we're about to write down.

Why?

Because the thing is that, what happens to carbonic acid?

Well, carbonic acid also goes through a dissolution reaction.

So this is CO_2 dissolving in water.

So carbonic acid goes like this.

OK, it goes into HCO_3^- plus H^+.

Now, here's the thing.

OK, what is the shell made of?

Well, the shell that's dissolving, the core material is calcium carbonate.

So that's $CaCO_3$.

That's the shell.

And the shell also has an equilibrium reaction that happens.

The shell of a sea creature is in dynamic equilibrium with the ocean.

And so it's going like this.

It's going to, well, OK, Ca^{2+} and CO_3^{2-}.

OK, but the thing is, it has an equilibrium constant.

All these have equilibrium constants.

So for example, for this one, the K_{sp}, the solubility product constant-- because this is a solid.

This is the solid shell, solid, going to ions in aqueous solution.

So the K_{sp} for that is somewhere around 5 times 10 to the minus ninth, 5 times 10 to the minus ninth.

Yeah, but here's the thing.

We just went through this.

If I consume one of these or change the concentration of one of these and not the other-- we just did this.

If I could change the concentration, if I consume any of these, then I might drive the reaction-- consume or produce.

If I change any of these independently, I'm going to drive the reaction, because that's how we keep to our K. That's what Le Chatelier's principle tells us.

And so what ends up happening is you've got the extra H+ ions.

So these are ions in solution.

Where did they come from?

They came from the CO2 giving us carbonic acid, which then gave us H+.

Those are what I'm talking about.

Well, they react with the CO3 2-.

This lowers the CO3 2- concentration near the shell-- [STUDENT SNEEZES]

--right?

Gesundheit.

And if I lower this, because I've taken some of this now and I've reacted it, so now I've got less of it.

And because of what we just saw, if I've got less of this, you're going to drive this way, which is going to dissolve more of the shell.

That's why this works.

Well, that's why this happens.

Works sounds like a positive thing.

So this lowers the concentration of CO_3^{2-}, and that drives more dissolution.

That is what's happening.

And we now can understand it in terms of the concepts that we've just learned.

Historically, I mentioned 50 million years.

Actually, by some accounts, it's 300 million.

It depends on which studies you read.

But for at least 50 and maybe as much as 300 million years, the ocean has had a pH of 8.18.

Now, where's the-- oh.

So let's just say last, oh, 50 to 300 millionish years, the ocean pH was 8.18.

And today, it's 8.07.

And the prediction is that in 2100, it will be 7.8.

Now, as we will see in a little bit-- and you say, what's pH?

And many of you probably already know, but I will tell you what it is in a little bit.

But because this is a logarithmic thing, this is a lot, right?

Today the ocean is 25% more acidic than it's been in 300 millionish years.

And in 2100, it will be 126% more acidic.

That's why they use 7.8 in the experiments of the pteropods.