Now why does this matter?

And I'm going to tell you an example of why this matters.

I'm talking about delocalization to stabilize.

And I'm talking about how the actual structure of a molecule isn't this rigid two bonds here, one bond there, that's not what that says, but it was in ozone.

But it's this shared equivalent bonds where the electron is shared and the whole system is lowered.

Now, there is one molecule where this is very much important and dictates all of its chemical behavior.

And that's benzene.

And back in the day, in the 1930s, oh, by the way, Pauling, electronegativity scale. we talked about him on Wednesday.

But back in the day, they didn't know what benzene was.

They could kind of measure some things.

But none of it worked.

And Pauling wrote a number of structural formulae have been proposed for benzene, but none of them is free from very serious objections.

The way they wrote stuff.

Look at these shapes for benzene.

If we don't know the right shape and why you have the right shape for benzene, then we cannot understand all of the mega amounts of organic chemistry that we do with benzene.

So this is what's happening with benzene.

You have these two structures that benzene actually averages over.

These are resonance structures.

Back in the day, they called them Kekulé structures because Kekulé, as you can see, was kind of close and thought about this as well.

These are resonance structures.

It totally dictates the chemistry of benzene, which then leads to massive amounts of things that we do with benzene.

Because with benzene, and this is just, we don't need to look at this in detail, this is an example of a few out of almost unlimited variations of benzene that we can make.

Because we can take one of those hydrogen atoms and put something on it, or two places.

And each time we do that, we get a different material, a different molecule that gives us different properties and different uses.

But all of this, even though we draw it, still with those lines, we know that inside, it's delocalized.

It's delocalized.

Well, it might change once you add stuff to it.

But by itself here, by itself here, it's delocalized.

And that sets up the properties of benzene.

Now OK, let's go a little farther.

So I like these last two here.

Naphthalene, now, you can keep on going, and keep adding benzenes, and we're going to get somewhere that I really love.

This is getting me excited.

Oh, look I'm going to add one there.

I'm just going to keep adding benzene.

Now I could stay here, oh, don't get benzene wrong.

I can keep going.

And if I kept going, I might get sheets of benzene that are now called graphene.

And if I stack those up, I've got graphite.

I've got graphite.

That's what graphite is.

It's these very large sheets of benzene.

Now, there are two very well-known phases of pure carbon.

One is diamond.

And the other is graphite.

Does anybody know which one is more stable?

How many people think graphite?

How many people think diamonds are forever?

I'm giving you guys some advice, especially like, you're out, and maybe you're out on a date.

And it's the weekend.

And there's a candle.

And you've talked about combustion.

And you've written that down.

And you talked about how long you have in that room, because you know about oxygen and the limiting reagent that it's either you or the candle.

We talked about that.

We also talked about how you need your periodic table on that date.

And how you may need your spectroscope, because they might give you an LED candle instead.

You need to talk about LEDs.

And I'm not saying that all of these conversations involving knowledge you gained in this class will lead to this place of seriousness, but it could lead to engagement.

It could.

And now, some people when they get engaged, one person buys the other a ring.

And sometimes that involves this material.

My point to you right now is when you go to the store, maybe it's Tiffany's, maybe it's somewhere else, and you buy that ring, ask for a warranty.

And make sure it's about 100,000 years, because after that time, that ring is going to turn into graphite, because graphite is the lowest most energetically stable form of carbon.

So I'm just, again, always trying to help.

But this is the most stable form of carbon.

And it's a bunch of benzene, but repeated.

Not benzene, the hydrogens are gone.

It's just pure graphene, but repeated in these beautiful rings.

And when we come back to hybridisation and molecular orbitals, which we'll start after exam one, you'll see other beautiful properties of structures like this.

By the way, speaking of seeing, you can see this material.

What are you throwing at this material to see it like that?

Not light, not photons, you're throwing electrons.

I just came across this the other day in Wired, New microscope shows the quantum world in crazy detail.

They took electrons and they shine it on these little particles of platinum and iron.

And they're able to literally see every single atom as they break apart the particle.

By just throwing electrons at it, they say, the transmission electron microscope was designed to break records.

Using its beam of electrons, scientists have glimpsed many types of viruses, et cetera, et cetera.

They got down to 0.4 angstrom resolution in that work.

It's a beautiful thing.

And being able to see these materials has revolutionized what we can do with them.