[SQUEAKING]

[RUSTLING]

[CLICKING]

Now, this gets me to why this matters, and that's how I want to end today's lecture in the last five minutes because we talked about emission, electrons transitioning from their discrete orbitals as a way of emitting or absorbing.

And so you if you have different atoms, there's hydrogen. These are the absorption lines-- absorption lines.

Carbon has absorption lines.

Oxygen, nitrogen, sulfur, so lots of things have absorption lines.

Why does this matter?

Well, of course, because of the refrigerator.

I love this plot.

This is a plot of the refrigerator.

This is the size of the refrigerator as a function of year.

The date only goes to 2002, but it's roughly stable now.

Does anybody know what's limiting the size of the refrigerator?

It was going up and up and up a lot, and then it stopped.

Does anybody know what limits that?

STUDENT: The average height [INAUDIBLE]..

PROFESSOR: It's the width of the doorway.

It's the width of the doorway.

That's why we don't-- that's why people get a second refrigerator.

And there's energy use.

Energy Star program, big deal.

Big deal.

But I'm talking about refrigerators for a different reason.

I'm talking about refrigerators because until the 1980s, the way we did cooling was with a chemical called chlorofluorocarbon.

This is a chemistry class, and we're going to be talking about-- when we talk about why this matters, we connect to the chemistry.

Well, the chemistry there was critical.

There was a molecule there called chlorofluorocarbon or CFC.

And the thing about that molecule is that its absorption, the chlorofluorocarbon-- so let's write it down here, CCl_3F.

There's a gas phase, so we put the little lower script g.

That molecule has its own absorption.

It has its own absorption, and it has its own reaction, and so do other things.

But it has a really important reaction because when it absorbs UV rays, then it doesn't just like then like electrons get pumped up.

No, the whole thing reacts.

And so this thing degrades into CCl_2F plus chlorine gas, and that's once it's up maybe in the atmosphere, which it was getting released all the time because of the refrigerators.

And the thing is that the chlorine gas would then react with ozone, and this would go to ClO plus O_2, and here's the problem.

I mean, we're already at a problem, but now it's a big problem because-- you can already tell.

But I've got ClO, and that's really reactive.

So what happens is ClO, which was a gas-- I'm just being careful here with my subjects-- would react with atomic oxygen to give you O_2 and the chlorine atom back.

And here's the thing.

Now I've got my chlorine atom again.

These are very reactive atoms in the atmosphere.

They love ozone.

And so this cycle for one CFC molecule would happen 100,000 times, roughly, before that chlorine kind of goes away and does something else-- 100,000 ozone molecules per CFC.

Why does that matter?

Well, it matters because-- I love this plot.

This is the energy of light from the sun hitting our planet.

So this is the energy that you get, and look at this.

This is the sun at the top of the atmosphere.

Here it is on Earth, the red.

Look at these things here.

If you could only see in this spectrum, the world would be dark because there's no light on the planet.

Why?

Because it's all absorbed in the upper atmosphere by water.

Absorption-- it's the same principle, Bohr.

Bohr's idea of electrons getting promoted when they absorb light is happening, and it's protecting us because right here, see, that's the UV.

Low wavelength, high energy.

UV, O3.

Look at that.

Look at what it's taking out.

That little sliver of yellow is critical.

And ozone was doing the job, and it still is.

But if we tear all that ozone out with these CFCs, we have a crisis.

And that led to what is one of the greatest policy decisions which was made in 1987-- it's called the Montreal Protocol-- to essentially globally ban-- the US led this.

This is a great example of how policy is so critical.

The US led this effort to ban CFCs, and we're almost back to normal ozone levels, and we avoid this.

And by the way, if this had happened, the prediction at the time was roughly 280 million additional cases of skin cancer over this generation.

This is a very big deal, and it all comes back to absorption of electrons by atoms and molecules.

See you guys on Friday.