PROFESSOR: What we've managed through badgering the utilities relentlessly is to get them to agree to measure part or all of the high-volume gas leaks that they're going to fix this next year. But we need a method to do that. So one part of today is hackathon. And you can choose which group you want to go with. The part that I'm going to be working on is coming up with that method to quickly, easily, using utility common tools, measure the emissions off of high-volume gas leaks. And if we can do this-- if it's possible-- the state will enact the regulations that this must be done with every high-volume gas leak from now on.

So this is an incredible chance to create a state-wide program to allow for feedback and transparency in the system to allow them to do their job much better in terms of reducing emissions from natural gas leaks. Does that somewhat make sense? And we've got some of the cool tools that the utilities use, and lots of information about how to do that.

PROFESSOR: So who knows what a gas leak smells like? That's the most kind of direct sensor we have-- our noses. Who doesn't really have a good idea of what a gas leak smells like? OK, great. Well, I have these scratch and sniff cards, so you can find out.

[LAUGHTER]

And so you open these things up. Does anyone want to remind themselves of what a gas leak smells like? Well, this can be a little reminder [INAUDIBLE]. OK, so, take one, and pass them around. You just open it up. And there's a little teardrop shaped blue thing. And you just scratch that, and you smell it.

AUDIENCE: Yeah.

PROFESSOR: OK. So you smell that? OK, so when I got into this, I didn't even know what a gas leak smelled like. Like, six years ago, I had no idea. And then once I smelled it, it's like riding a bike. Now, if you haven't smelled it-- you're going to have that--

AUDIENCE: What's the chemical in the smell?

PROFESSOR: Yeah, it's a family of compounds called mercaptans. They're all sulfur-based compounds. And our noses are just very, very sensitive to them. They're injected into the gas because methane itself is odorless. And it was actually mandated by federal law to be put in there after a huge explosion happened in New London, Texas, that killed hundreds of kids in that school. And no one smelled it. So this odorant is added at the parts per billion range. It's like maybe five to 10 parts per billion of this odorant, mercaptan.

So we use a number of techniques to measure these gas leaks. As a citizen and as community science, your nose is really a very powerful sensor. The industry, what they do is they use some sniffers. They've been around for decades. One of the things they do is use this thing called a combustible gas indicator.

And I'll just turn it on. You can hear the noise. That's a pump. And so it's pulling in air through this little hole here. Often there's an extension on this so that it can go deeper down-- like a meter down into the ground. So good thing-- right now, we're measuring 0-- 0% gas. OK? This thing's pulling in about a half a liter per minute. That's the pump. So you see the 0 there.

And when we go out on our drive-around on the 31st-- those of you who can make it-- if we come upon a gas leak in our very high precision, very sensitive sniffer-- this one's a little bit more coarse. But we can get out, and poke around, and find out, and pinpoint where is it under the surface that that gas is coming out. OK? So maybe I'll just-- oh, I don't know. I guess I'll turn this off.

AUDIENCE: Might have to do a controlled experiment where you can match people against that. So send people and one of them. You know?

PROFESSOR: Yeah. You know, that's a good idea. But I will tell you, the lower limit on this thing is about 500 parts per million methane. That's the lower detection limit on this, which is very high. Does anyone know what the background methane value is in our atmosphere in units of parts per million? Any wild guesses?

AUDIENCE: Two per billion.

PROFESSOR: Yeah, per million-- a little over two parts per million. 40,000 parts per million is when it gets explosive-- 40,000 parts per million. OK?

AUDIENCE: That's 80 times [INAUDIBLE].

PROFESSOR: Yes. So there's different ranges at which this problem has different impacts. Our global value of two parts per million now is about something like 50% greater than it was in the pre-industrial condition. And so the greenhouse gas impacts of even two parts per million is very big. The instrumentation in our band-- GPS-enabled sniffer detected a series of leaks along about a 1/8 of a mile portion of that street. So we've got this graph-- and I will show you later-- with these peaks that come out. They could be plotted right out on Google Earth, OK?

It's probable that those leaks are not coming from the new pipe-- the new West Roxbury Lateral. But they're probably coming from the adjacent pipes that are old and leaking that have already been there. The real lost opportunity there, in addition to the fact that we don't need the new pipeline, is that they paved brand-new paving and brand-new sidewalks. They didn't fix the old leaking pipelines when they put in this brand-new pipeline. And Eversource, whose territory that is, by the way, is a coinvestor in the West Roxbury Lateral Pipeline. So apparently, they just didn't care about maintaining their own infrastructure.

AUDIENCE: Why wasn't it mandated? Why wouldn't the state--

AUDIENCE: Working on it.

PROFESSOR: Yeah. So anyway, that's what happened. And so we took a picture of this. We have the data set. And what you'll see is peaks and valleys. There may be like 15 or 20 of them. But are there are 15 or 20 leaks. We don't know.

And if you want to go over to the section that we're working at, you will be able to think about, is like, what is a leak? How many leaks are there when you get this series of spikes? If the spikes go like that-- tip down, and come back up again, and go down, is that one leak or two leaks? And the fact of the matter is we don't yet have a very universal definition of what a leak is. So you will help do a leak count. And you'll help determine, hopefully, what an objective leak analysis can be by looking at these Google Earth images of gas leaks.

PROFESSOR: And they're gorgeous images. And it's just super fun. You feel like you're the only one who knows this information. It's great.

AUDIENCE: Do you know the material of recent leak types and [INAUDIBLE]?

PROFESSOR: Yeah, so the leak-prone pipe-- most of it is cast iron. And it goes back-- some pipes are over 100 years old. I think Audrey might have mentioned. There's also wrought iron. There's not much of that. But that's a very old leak-prone pipe as well. Bare steel is another leak-prone pipe. They're all being replaced-- well, when they're replaced, they're replaced with plastic pipe. And that is not as leaky because it's newer.

AUDIENCE: This may be the wrong question, wrong time. Three or four years ago, there was a big issue here with Google Maps. And then Google outfitted every single car, and tracked and published their gas leaks all over the place. And rather humorously, Wellesley, was one of the biggest centers of the universe of gas leaks that they found. As they did all the Google drive-bys, they [INAUDIBLE]. They didn't know where that fit into this town [INAUDIBLE] technology they were using. But they published this, and all this, but that--

PROFESSOR: Yeah. So we published our Boston data in 2013. And that was all of the gas [INAUDIBLE]-- over 3,000 leaks in Boston. Very soon after that, Google partnered with the Environmental Defense Fund to basically take this nationwide. And so part of doing that was coming back to the greater Boston area. And they did their own map. They got one leak per mile in Boston. We got four leaks per mile in Boston. So that's part of figuring this out.

So almost everything that's under the streets and sidewalks in Boston, Somerville, Cambridge, Newton, Brookline, is just about a half a pound per square inch of pressure under the streets and sidewalks. But it's like a tree. You have these trunk lines. And you have the big branches. And then you have the little twigs. So you have these intermediate branches running down Route 9 that-- it's either 22 or it's 40 psi. And it's leaking.

PROFESSOR: So today, you'll either decide to work on visualizing the data, looking at the data, or working on figuring out how to measure the high-volume gas leaks. So you'll sort of self-select into whatever group you want to do. Is there a question back here?

AUDIENCE: Just a basic question. Do you know how deep these lines were buried?

PROFESSOR: Yeah, it's variable. About three feet is generally how deep they are. They put them deep enough that it will reduce the frequency with which they freeze. But in frost conditions-- deep freezes-- you can get mechanical disturbance due to frost. And you can have broken mains, and things like that. But anything's possible.

You know, one thing I've learned is that I mean, for the most part, gas lines run along the same axis as a street. But they'll run diagonal. And they'll be on both sides of the street. And they'll run under sidewalks. And they'll go this way and that. And I can just see any configuration. There's a legacy effect of this. It can be like spaghetti down there.

AUDIENCE: Are there maps of the existing pipeline?

PROFESSOR: Yes, and no. There are public documents that show the operating pressure for that natural grid's service area. And I can share that graph. But there's not the detailed information on those maps that tell you the diameter, the age, and the material of all of the pipes. There are selected parts that we know of. I mean, some of these have, obviously, these maps. But they're not public. Only some have been made public. And it's very selective.

PROFESSOR: So you can look at how to visualize the data, and get to figure out how many leaks there are in Chelsea-- how exciting-- and actually see where the leaks are, or figure out how to measure the emissions.