# MDH Speaks: "Environmental Radiation" by Jesse Fillmore (10:13)

**Anna Strain**: "We are onto our final speaker for today. I want to welcome Jesse Fillmore to the stage this afternoon. He is a Research Scientist at the Public Health Laboratory. He appreciates being able to enjoy the outdoors, both for a sport and for play. He enjoys coaching his daughter's basketball team and adores her curiosity and love for exploring life. His talk is titled 'Environmental Radiochemistry.'"

[applause]

**Jesse Filmore**: "So, I'm Jesse Fillmore. I'm from the Public Health Laboratory. I'm in the Inorganic Unit, and I deal with Environmental Radiochemistry. So that's what my presentation will be about.

"I have a few things that I want everybody to walk away from. After this presentation, I want you to be able to define what radiation is. I want you to understand how we monitor and detect and measure environmental radiation in the Public Health Lab. And I also want to be able to list some everyday exposures to environmental radiation that we all have every single day.

"First things first. Most of our education with radiation comes from Hollywood. Movies like 'Godzilla,' 'The Hulk,' 'China Syndrome,' and episodes of 'The Simpsons' with this three-eyed fish. These examples are very entertaining; however, they are mostly fictitious about radiation.

"I want to ask - you don't have to yell out loud, you can if you want, but it doesn't matter - if I asked you to define what radiation is, what would you tell me what radiation is? There's lots of really good definitions out there. I like this definition the best. It's short, sweet, simple: 'Radiation is energy that is transmitted from one body that travels through a medium to be absorbed by another body.' And that's it. That's all radiation is, is just energy.

"This slide is kind of daunting. But don't worry, we're just going to go over a few things. There's two forms of radiation and that's it. Only two forms of electromagnetic radiation. They are called Non-ionizing and Ionizing. And it's all based on energy. Most of us are familiar with non-ionizing forms of radiation - that's radio waves, microwave waves, heat, infrared waves, also cell phone communications waves as well. The other side, ionizing radiation is what most of us think of as atomic radiation or nuclear radiation - this is like gamma rays, x-rays and some forms of UV light. The only difference between these two is energy. The ionizing forms have more energy than the non-ionizing forms.

**Jesse Fillmore (con't)**: "In order to understand what those two words mean, we're going back to chemistry basics. This is just a structure of an atom. Atoms consist of protons, neutrons and electrons. The protons and neutrons are wrapped tightly together, bound tightly together in the nucleus of the atom, and they're surrounded by electron clouds or electron shells. So just like most people, atoms like to be stable. Unstable atoms with too many or too few neutrons contain excess energy and are therefore not stable. They emit this excess energy in the form of ionizing radiation. Therefore, unstable atoms are radioactive. Ionization is just a conversion of an atom to an iron by removing a charge particle. That's all it is.

"So non-ionizing radiation, if you're sitting by a campfire and you put your hands out, you're not right on the flames, you're close to them. But you can feel that heat. You're actually being irradiated by the fire. That's energy moving from fire through the air to your hand. So it's warming it up and exciting the atoms in your hands.

"But it's not actually changing the electronic structure of the atom. Ionizing radiation, which is that gamma x-ray type of radiation, which we looked for in the lab that does have enough energy in order to create an iron or change the electronic structure of your atom. So those are the only two differences. The cell phone, that's also non-ionizing radiation, so all those papers you read about cell phones and all sorts of things, remember; it's not ionizing radiation. It doesn't have enough energy to chemically change that or to electronically change the structure.

"The types of ionizing radiation that we look for in the lab - alpha and beta particles based on their name, their particulate nature - that means they have mass. This is important in our lab for radiation safety. They lose a large amount of energy in a very short linear space. The other form are gamma rays. These are photons. These are massless photons, no different than the lights in this room. When you turn on the lights in your room and the room lights up, those are photons. They just have more energy. Remember, they have enough energy to ionize atoms with the interactions that they have.

"So radiation is all around us all the time. In Minnesota, we get a roughly 300 millirem per year. So don't worry about the millirem, that's just a dose of annual radiation we get just from walking around and breathing and being alive. So especially in Minnesota, about 60% of that is from radon in our homes. Most of us have heard about radon gas, and that's just a naturally occurring decay product of uranium in our soil and in the rock underneath us. Because it's a gas, it percolates up through the soil, finds cracks in the foundation of your house and can seep in and give us a dose. The foods we eat and the water we drink all contain small amounts of naturally occurring ionizing radiation, which we look for in the lab - cosmic radiation. We're bombarded constantly with cosmic ionizing radiation, along with terrestrial radiation.

"This slide I just wanted to show a couple of manmade and natural doses we get from radiation. So a flight from New York to London by air will give us an additional dose of about five millirem. So why is that? Well, when you're flying at altitude much higher than sea level, there's less atmosphere. That atmosphere absorbs the energy from the cosmic radiation. So when you're at altitude, you're actually exposed to more cosmic energy, and you get a slightly higher dose. A chest x-ray, we get about ten millirem, but chest x-rays are very, very good. It's a very small dose that we're getting from a chest x-ray. If you have a broken rib or something to check out, it's very worthwhile to get those things.

**Jesse Fillmore (con't)**: “Smoking actually causes quite a large dose. I always found this interesting because this is because the tobacco plant preferentially takes up polonium 210, which is again another naturally occurring ionizing radiation. When the tobacco leaf is dried out, crumbled up, inhaled or smoked, that form of radiation lodges in your lungs and continues to emit ionizing radiation into your lungs. Smoking actually gives us quite a large dose. Other radionuclide we look for in the lab: iodine 131, cobalt 60, these are medical use type of drugs, medical therapy, type of drugs, potassium 40, radium 226, in our drinking water and in our food naturally occurring radiation.

“So just to wrap it up: common sources of radon in our homes, the foods we eat, the water we drink, the top, middle and top right sources of radiation are kitty litter and fertilizer. All of these things, the gypsum in our in our sheet rock all contain natural forms of thorium, uranium and different ways. So we're exposed all the time, every hour, minute, second of every day to ionizing radiation. So it's all around us.

“Our role in all of this is that we're certified by the EPA to analyze for drinking water samples. That's primarily what we do. We analyze the water samples to ensure that the levels are safe for all people to drink. We also monitor air filter samples around the state. We have a number of sealed sources in our lab that we have to monitor and ensure the integrity of. And we also have a monitor of vegetation and food samples. Specifically we analyzed for strontium, radium, tritium, natural uranium, alpha and beta emitters and gamma emitters. The instrumentation we use, our gas proportional counters on the top left, a metal liquid scintillation counter in the right, and gamma detectors on the bottom. The interesting thing about the instrumentation we use is that they all work in a very similar fashion. We're not actually detecting the ionizing radiation itself. We're detecting the effects of the ionizing radiation on a gas or a part of a detector. So essentially all we're detecting is, remember how I said how ionizing radiation creates an ion and it's a charged particle? So we're detecting those charges. We're detecting an electrical charge or maybe a beam of light, the result of the ionizing radiation. And then we can figure out how much ionizing material is in our sample.

“So while we are certified and able to test drinking water and that's primarily what we do, we also would be able to and would be expected to analyze for other samples in the event of any emergency radiological emergency in Minnesota, if there were a radiological emergency, generally we're going to have early phase samples. These would be like air filter samples and wipes. The reason for this is that they're relatively easy to collect. They're quick. We can analyze them quickly and get that data to decision makers in order to find out what's kind of going on later. Phase samples are everything like surface water, drinking water, animal feed, human food, fruits, vegetables, all this stuff. So our lab would be responsible for that.

“The way we're able to do that is our lab is made up of a great group of volunteers. It's our REPP program, Radiological Emergency Preparedness Program, and we are able to set up shop for a 24/7 operation to receive, analyze and also send that data out in the event of any nuclear emergency or other radiological threat in the state of Minnesota. By combining this with day to day work we do, we're able to really try to protect, maintain and improve the health of all Minnesotans.

**Jesse Fillmore (con't)**: "So with that being said, I hope everybody was able to achieve these three goals. You now have a good idea of what radiation is. You have an idea of how we detect and measure radiation in our lab, and you understand if there are everyday sources all the time that we're exposed to ionizing radiation.

"Thank you."

[applause]

**Anna Strain**: "Well, that was for the last of our speakers that we had scheduled for today. Hopefully you learned a lot about how we screen and test for Infectious Diseases and how we monitor our environment to keep people healthy. We didn't have an opportunity this time to hear from our Newborn Screening Section within the laboratory, but hopefully that can be on our agenda for our next MDH Speaks event.

"I do want to take that opportunity to ask all of our speakers to just come up briefly so we can give them another round of applause and thank them for their presentations. [applause] Well, I want to thank you all again for coming. This is being recorded and hopefully will be able to share those out in small clips. Thank you all for coming today, thank you!"

[applause]