

Welcome to the Baloney Detection Podcast. I am your host, James Kabrhel, AKA doctor K. This podcast combines my love for teaching with my desire to breakdown and debunk pseudoscience and scientific misinformation. Each episode, we will look at a different topic, or we'll have a lovely conversation with someone with a unique perspective on science and education. Today's episode is a really important one, at least it is for me.

I have been teaching this kind of information for a long time. And if you have listened to my introduction and background podcast episode, I did discuss some of that already. Okay. So the first part of this episode is going to be about scientific communication. The second part is going to be about language. So I want to provide quite a bit of background first before we get into specific words. There are going to be aspects of this podcast that I am going to hit on that I will likely elaborate on even further in subsequent podcasts. So this is not the last you'll be hearing about a few of these different topics.

The most important thing I want to get to first is, how do we as humans communicate in 2024, we'll compare this to how humans were communicating back when I was first teaching and back when I was growing up. So where do we get our media these days? So media being the operative word, the other word that goes with that is social. So if you think about particularly for younger people, and as an educator, I'm speaking about our students, they're getting it from social media. It's not even Internet websites anymore. And I can say this because my spouse and I when we teach our sustainability chemistry class, we ask students where they're getting their information. And it's TikTok. It's Instagram. It's Facebook, although less Facebook these days because let's say it properly. Facebook is an old person's social media platform these days. So students are not getting their information from terrestrial TV stations. They're not getting it from new sites. They're getting it from whatever social media platform is their favorite. Now, this is This is generalization, but it's not every student, obviously. So even though they may see it on social media, they could connect into an Internet news site or scientific website. And then they're sharing information, texting, MOGs gifts, means. I've even doing a lot of that to sort of engage with my students that way. Potentially streaming television, but even then, you know, how many of those streaming television services are giving scientific information they are they giving news information? No, it's TV shows. So that's where streaming television sort of fits in.

Because we have gone online, and we're seeing text communication via text message and direct messaging on social media platforms. Communication has sort of evolved into something less personal and without the visual clues that often help particularly me because I'm a visual person, engage with other people. So if you go on Internet forum, sometimes there's a sarcasm font or you will add in a MGs or, you know, you see, you know, someone type out something and then just do JK for just kidding. So there are ways of sort of emoting when you're using just text. Okay. And this is the evolution of the written letter, I suppose you could say, you know, it's in a written letter, you know, or

notes passing notes in class like I used to do when I was when I was in high school. There are ways that you can get your emotion or intention over that way, but it's more challenging. You know, when you see someone's face, oftentimes it's a lot easier to know what they're getting at with their communication. So with these new platforms, how is the communication of science affected? So let's establish first how scientific communication comes about. So we start with the scientific method. You have a researcher that has established data to support a hypothesis. It's been repeated for aca academics and industrial chemists, researchers in general, you're talking about the peer review process. So, let's say that. Whatever the scientific information is, it has gone through the peer review process. It has been published in a journal. There are two versions of that now. There's the full peer review process and now there is open access. So that's the difference between those two things is something for another episode. But the information is getting out there somehow. Then you can have that information put onto scientific news websites. They can sometimes get into the national news. And we've seen this kind of process most recently with the COVID pandemic. Rapid information. Is it trustworthy? Is it coming from a peer reviewed source? If it's peer reviewed, is it open source to get it out faster. So this kind of communication, we've seen the microcosm of it because we have dealt with a very severe circumstance over the past couple of years. And You can think about things like ivermectin, bleach, vaccines, you know, the positive/negative side of transmitting scientific information and misinformation through that. But this process is not new. The media on which these pieces of information are transmitted are different.

So I decided to go back and see if I could find some literature from years ago to see how dissimilar or similar this process is. So there's a book that I read called Vitamins and Health Foods, the Great American Hustle by Victor Herbert and Stephen Barrett. This is from 1981. And it was really a kind of debunking pseudoscience book from 40 plus years ago. And it just so happened to be based in the Lehigh Valley in Pennsylvania close to where I grew up. The focus of the book was about the practices of health food stores and pharmacies where 40 some years ago, that's where most people were getting their medical information, health information if it was not from a doctor. And at the time, you're talking about mail order services, magazines, newspapers. So the printed word was the way that people were getting their information along with word of mouth. So talking to talking to pharmacists, talking to health food store owners and salesmen and their doctors. And it really was still a lot of information about supplements, about miracle cures. And we see all of that. Today, I just happens to be on the Internet. So the platform has changed, but the information and the people who are using that information to take advantage of others, typically for money, that really hasn't changed very much. So even though I would say the speed of which we can get that information is the one thing that has changed. So you know, if you think about get using a mail order service to get a supplement, well, you could you're still getting these things through mail, potentially, but now you can order them from Amazon or any other website and you can get rapid shipping and get it within 24 hours. And It frustrates me sometimes that the proliferation is significant because now people can feel comfortable creating their own

products and having a ready made audience that is not as slow as the mail order service and printing and all of that. I put it on a website. You have your product ready. You can easily set up a sales platform because there are apps and websites that allow you to do that, and then you can go into business for yourself. So it's that aspect of things is much easier to do than previously.

We will end up getting into likely specific platforms for scientific misinformation in the future. But I wanted to provide this as a background to look at specific language. It's the language itself that I feel like is more important right now than the platforms. Because the language if you can understand what language is and how it's being used for or against you, it doesn't really matter what the platform is of this misinformation pseudoscience disinformation because you will be able to resist its influence, whether it's in a book or a magazine or a newspaper or an Internet website or a store front, anything like that. So we'll leave this discussion of social media for now to focus on some very specific words. And I'm going to go through them one at a time, and I want you to understand that this is really no different for this platform for me talking about it than it is in my classrooms online and in person because I teach about them in the very same way. And aside, before we get to specific words, When I begin teaching chemistry classes, I often frame the course as learning a different language. Because there is so much specific terminology to chemistry and virtually any scientific discipline, there are words and phrases and definitions and descriptions that are specific to that particular discipline. One of the words that we'll talk about today hits home with that particular sentiment. Okay. So I am going to be describing specific words to you with the intention of educating you about what they mean and what people think they mean. Okay. And it's the way that I teach these things is no different than I would in the classroom. Framing a conversation about a word, a concept in terms of what people think it means and what it really means. Getting someone to understand the meaning of language can go a long way to better communication between people, whether it's scientific or not.

So let's first talk about the word natural. And I will reference a specific book called Natural How faith in Nature's goodness leads to harmful fads, Unjust laws and flawed science by Alan Levinovitz. So I will be covering some of what Alan mentioned in his book, but also some of the things that I have seen and I feel about this particular word. So let's talk first about how people view nature. Nature it's beautiful. It's mysterious. It's green, it's blue, it's all sorts of different colors. It's where we get our food. It's the air we breathe. It's the ground we walk on. Amazing animals. Devastation from natural disasters, the weather. There are so many different aspects of nature. But one of the interesting views of nature is the mystical and the sacred. Not that nature isn't mystical and sacred in its own way, but some people elevate it to the level of God. You know, and there are religions or spiritualisms that are based on nature. I personally view nature as absolutely wondrous. I love being outside. But I also know that anything that exists has its own chemistry is made up of chemicals, that there are a lot of things out there that would be very happy to kill me. Whether we're talking about an animal, a bacterium, a virus,

something that's poisonous in terms of a plant, whether there is an intention to kill me or not, there's a lot of stuff out there that's pretty scary. So I give nature a lot of respect. But as Alan points out in his book, some people elevate nature in such a way to make it better than what we as humans can create. Somehow that something that is construed as being natural is better than something that is the opposite word to natural or nature is typically synthetic.

Natural to me, doesn't really have a scientific meaning. And that is because everything in nature. Earth, space, everything in between living, not living is made up of the building blocks of the universe, and that is to a chemist, atoms. To a physicist, it probably would be the sum atomic particles. But as this is not a chemistry podcast, we're a physics podcast for that matter, we're not going to be getting into that sort of thing. So for me as a scientist and as an educator, I don't get into the mystical or spiritual part of nature very much. I can see a plant. I know that there is photosynthesis. I know that there are chemicals inside a biochemical processes that are always working. There are things that I cannot see happening. Those particular biochemical processes, for instance, But I know that people have studied them and know how they work, for the most part. So when I see a product that has the word natural on it, I know what the intention of the creator of that product, the seller of that product is, is to make it seem like it is better than something that was made synthetically. That's the intention. That's how these people make their money. But from a scientific aspect, the word natural doesn't have a real meaning. It's, you can imagine different contexts for that. Now, legally, if you think about what's on a supplement bottle, natural has a connotation, but again, it could mean absolutely anything.

The second word, and this is more personal to me is organic. So the word organic has infiltrated our society to the point that there is an entire section in every grocery store that has the word organic on it. And we think about food that is intended to be healthier for us, that it has been grown in a different situation than other non organic foods. And we can spend more time talking about those differences. But to a chemist, the word organic means carbon. Organic substances contain carbon. We are carbon based life forms. We need carbon. We are made of carbon, so that we are organic. Anything that does not contain carbon is considered to be scientifically inorganic without carbon. All of this is wrapped up in chemicals, chemistry and the fundamental building blocks of the universe. So I could have reordered the discussion of these three specific words, natural organic and then chemical. But I think natural and organic are viewed as less fearful words than chemicals. Okay. And you can sort of compare, you know, sometimes instead of natural and synthetic, you could think about the opposites being natural and chemicals. So, chemicals, the connotation of chemical or chemicals or chemistry is synthetic. Something that is done in the lab by a scientist. A chemical is something that is made of atoms. It could be the same atoms or different atoms of different elements, and it exists. So chemicals are matter. The objects that make up the universe. Anything that we can see, taste, touch, smell. Anything that exists is made up of chemicals

somehow. The list of chemicals are based on the 118 known elements that we put on the periodic table. So that's sort of the roadmap of chemistry is the periodic table. If everything that exists is made of chemicals, then the only thing that is chemical free is a vacuum, the absence of chemicals, an absolute vacuum, the absence of any kind of gas, liquid or solid, or anything else. That's the only thing. That can be chemical free. And yet, if you think about all of these three words, you have products out there that are natural organic or chemical free. I tend to focus on these words first because they are out there in the public, particularly on consumer products. And you hear them talked about all the time. Natural is better, organic is better, chemicals are bad. Except that any product that is suggested to be natural or organic or both is made of chemicals. So let's think about something a chemical that is fundamental to us. Sugar. We have been isolating sugar from nature from organisms for a very long time. We know what its chemical structure is. The specific sugar and sugar is a general term. The specific sugar that I'm referring to is sucrose. That is our table sugar. It has a chemical formula of $C_{12}H_{22}O_{11}$. We know how many atoms are in that compound, and we know the way that they are bonded together. So it has a three dimensional structure. If you were to synthesize sucrose in the lab from its monosaccharides, glucose and fructose, it would have the same chemical structure. As that sucrose isolated from, say, sugar cane. There's no difference. Chemically, they are identical. Because any chemical has a set of properties, a melting point, a boiling point, a taste, an odor, a way it interacts with the body, and a naturally isolated molecule of sucrose would behave in the same exact way as a synthetic molecule of sucrose. There's no chemical difference between the two. One thing that you can separate out from that fact is that there are economic societal aspects of isolating a product that can bring in a lot of moral discussion. Okay. So just saying natural synthetic, natural versus chemical, organic.

There are other discussions to be had about how we get our materials. And that is not the discussion that I'm having with you today. I'm only talking about the fundamental nature of the molecules and what they would do. And a chemical, regardless of what it is, is going to behave the same way regardless of where it came from. Because it's chemical reactivity depends on its structure, not on where it came from. And this is something really important to teach any student and to teach you before we move on to potentially more challenging discussions about, if we're talking about sugar, the environmental aspects of isolating it from nature, the use of labor, the cost, but that has nothing to do with its chemical structure. And it's the same thing about the word organic. A scientific meaning it's based in carbon. That is separate from, what about the products that are in different sections of the produce in the grocery organic and nonorganic? That's an entirely different discussion, which we will have in the future. So I emphasize using the right kind of language as much as possible. And I will use the right kind of language with you as much as possible. If there is a particular term that I feel like is important for one of these episodes, I will explain it and define it in detail. Because I want you to be able to understand what these words mean.

Language is incredibly important to communication. Okay. And this is true whether you're talking about chemistry or psychology or economics or politics. Words matter. The meaning of words matter. So I want to be open as honest with you as possible and also describe things in as much detail as possible. So you can understand. So we will likely talk about nature and natural more. I will probably talk about organic food in a separate episode. We'll talk about chemicals and chemical-free in reference to the fear of chemicals, which we call chemophobia. And then we will talk about peer review process in more detail. And some of that will be in reference to the COVID pandemic because that provides a really fertile ground for discussion about peer review and how we develop chemicals, how we develop drugs, how we develop vaccines. Vaccines will probably have its own episode because there's a lot to unpack there also. So this is just the beginning of our conversations related to words and their meanings because they are incredibly important. It's always good to have the right definition of something before you start talking about it. And talking about chemistry and science and communication related to those things requires the right definitions of things. And I will leave it to you if there are specific things that you feel like you don't have enough information about. We can talk about them. I only have so many ideas for these podcasts right now. And just like I am in the classroom, I rely on people I'm talking to to give me ideas. A conversation goes two ways. Scientific communication goes two ways, or many different ways. So this is not just me talking at you.

This is a request for you to share with me your thoughts, things that you want to learn about. And I will do my best. If I don't know enough about a topic or I don't feel comfortable being an expert expert on a particular topic, I will say so. And I will point you in the right direction. We will have conversations with guests about specific topics that I am not an expert on because I want to show you that I am willing to learn also. I am always willing to learn. Okay. So please engage with me as much as you can, whether it's about these words or about other things that we will talk about going into the future. And I really look forward to that. So we'll stop here today, and I hope you have a lot of different things to think about before the next episode. And I promise that we will be getting back to a lot of this discussion about words in the future. You will hear me use these words a lot and frame them in this context. So until next time, I wish you the best please keep listening. Baloney Detection is a production of Phoenix Studios at the University of Wisconsin Green Bay. Phoenix Studio's executive producer is Ryan Martin, and the production manager is Rachel Scray. Our audio production coordinator is Bill Salk. Our graphic designer for Baloney Detection is Logan Severance. If you haven't already, please remember to rate, review, and subscribe to our podcast on your favorite podcast platform. You can also head over to our website at UWB.EDU/Podcasts to check out past episodes of this and all of our shows. I'm your host, doctor K. Thanks for listening. B good people and do good things.