Presentation 9 Nutrition- Summer Session July 29, 2020

Unit 10 Nutrition's All about You- and Your Gut Biome

WHY IS THERE SO MUCH MISINFORMATION? . (2:56)

In medicine, psychology, sociology, and all the disciplines associated with human research, the typical standard to claim that whatever **you're testing is a real effect is a 95% confidence limit, which means that the measurement will happen on accident only 5% of the time**. In other words, scientific results done carefully and properly, with no hints of bias in the measurement, will find a health risk or benefit about 5% of the time, even if there is no actual risk or benefit. (9:59)

And the biases of publication mean that the measurements that say there is an effect are more likely to be published, even if the measurement is a statistical fluke. Researchers don't get promotions, grants, and tenure on the basis of null results, and **journals tend to be not so interested in null results**. **So, there is a system-wide bias toward publishing only the papers that establish a hazard or a benefit. ..**

The bottom line is that **you should be enormously suspicious of a single measurement touting a particular health risk or benefit**. There's a good chance that if you see a single measurement, it's wrong. It's not guaranteed wrong, but you would be wise to wait for independent confirmation. (10:24)..

This covers the generally honest world of research. But odds are you are not reading the research journals. **Most likely, if you hear about a research result, you heard it in the media or on the internet. This is where things get disreputable**. (10:43)

In this age of the internet, articles often claim a health risk or benefit associated with some food group—such as red wine or dark chocolate—when there is no **real** effect-"Sadly"….

If you've ever **read a research paper**, you'll **notice the spectacular number of cautions**, **qualifiers, mentions of special cases, etc**. There's nothing that **a scientist hates more than being wrong,** which can bring ridicule from one's peers and intellectual backlash. . (11:05).

But a science journalist has a different mission. **He or she needs to explain the big idea and the significance of the publication, which means stripping out much of the nuance and cautionary statements. ..** (11:19)

People who write for reputable popular **science outlets**, such as **Scientific American and Discover magazine**, often have a scientific background, and their readers or viewers have a modicum of technical sophistication. This allows the popular science journalists the ability to retain at least some of the caution. .. (11:55)

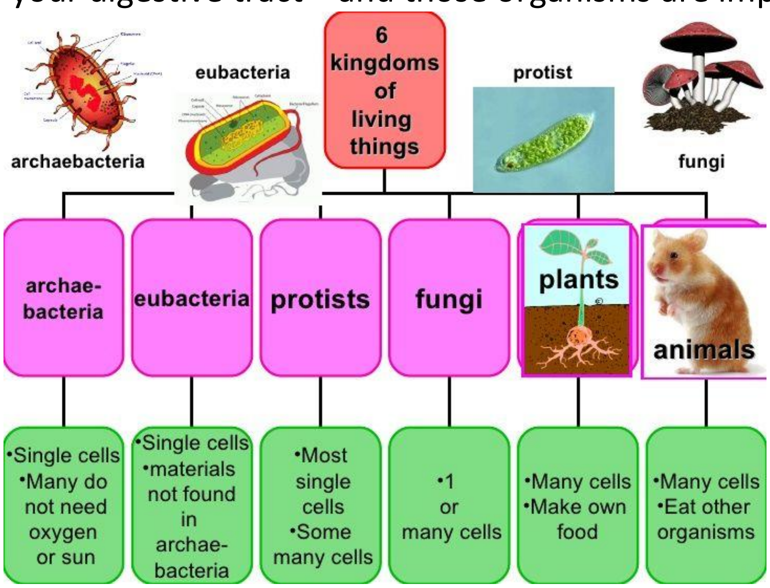
If a science story becomes big enough, it might rise to the attention of the **bigger media outlets**, such as a television network or its associated webpages—**think of CNN, Fox, ABC, CBS,**

and NBC. Another type of media that caters to a very broad audience is the traditional print media, including newspapers and magazines, such as *The New York Times and The Washington Post. ..* (12:24)

Because these media outlets cater to a very broad and frequently unsophisticated audience, even more nuance must be stripped away. Eventually, marketing agencies join the fun, and they have no nuance at all. ..So, the next time you see a medical story in mass media or on the internet, be careful. (15:54)

YOUR GUT MICROBIOME .. (15:55)

There are microscopic organisms living in your body—especially, but not exclusively, in your digestive tract—and those organisms are important to your health. (16:43)



The term microbiota refers to the entire panoply (a complete or impressive collection of things.**)of microscopic organisms** living inside you. These organisms include bacteria, archaea, protests, fungi, and viruses.

These creatures have been found to play crucial roles in your metabolism, immune system, and balancing hormones. (17:24)

Inside your body is a jungle, with an enormous number of species living and dying and competing for resources. And those species have a serious impact on your body and health. .. (17:44)

This internal ecosystem of microorganisms that live inside you is referred to as **a microbiome.** Importantly, **not everyone has the same microbiome**; the mix of critters living inside one person can differ from the mix that lives inside another. . (18:19).

You get your microbiome from many places. The **first place** you get them is from your **mother at birth**—you inherit her microbiome. This is **especially true for vaginal births**, and somewhat **less so for Caesarean sections**. Prior to birth, **the amniotic sack protects a fetus from all kinds of microorganisms. .** (18:45)**.**

You also eat foods that have their own microbiomes, and some of those organisms take up residence in your gut. Then there are your life experiences, where you shake hands, kiss, touch doorknobs, and pick up organisms from the world around you in many other ways. ..

And you might be surprised by just how much of you is actually nonhuman cells. Mind you, this is very recent science, so it is evolving rapidly, and the understanding will improve. **In 2014, it was reported that there are 10 times as many nonhuman cells as human cells in your body.** But the **numbers for human cells and microbiome cells were estimates**, and work continued. .. (19:42)

In 2016, another group reported that there are 1.3 nonhuman cells for every human cell, with an **uncertainty of 25%.** And this number wasn't the same for all people; **it varied as much as 50% from person to person.** Still, the rough number of one nonhuman cell to one human cell is a pretty good modern estimate. (20:05)

Recent scholarship has focused on the microbiome ecosystem in the human gut. Not long ago, the idea of persistent organisms living in the stomach was considered to be a silly idea. After all, **the human stomach is full of acid, with an acid concentration that is sufficient to kill most microorganisms. .** (20:23)**.**

In 1984, gastroenterologist Barry Marshall drank a beaker full of lukewarm beef extract mixed with a small amount of bacteria. Three days later, he was vomiting, and his mother told him that he had bad breath; the bacteria had taken up residence in his stomach. A few days later, he took antibiotics that killed the bacteria. .. (20:46)

Marshall proved that Helicobacter pylori bacteria could cause acute gastritis, which in turn **could cause ulcers**. In other words, Marshall proved that **ulcers were caused by bacteria**. (21:01)..

Approximately 3 out of 4 ulcers are due to Helicobacter pylori bacteria.

For his work on bacteria, **Barry Marshall shared the 2005 Nobel Prize in Medicine** .

Prior to his experiment, the prevailing idea was that ulcers were caused by stress, such as a bad relationship, a difficult job, or not enough money. But we now know that the proper way **to treat an ulcer isn't with tranquilizers, antacids, mood elevators, or antidepressants.** What is needed is a course of antibiotics. (21:29)

GUT BIOME STUDIES ..

One of the big medical fights in the Western world—and especially America—**is obesity**. **A third of Americans are obese. Two-thirds are at least overweight**. And obesity is a tremendous health risk. It's linked to diabetes, stroke, heart disease, and the chances of premature death. (22:41)

In 2013, **gut microbiologist Jeffrey Gordon** and colleagues published a fascinating paper in the journal Science, the flagship journal of the American Association for the Advancement of Science. **They studied the microbiome of heavy people and skinny ones and found that thin people had a much more diverse set of bacteria in their gut compared to heavy people. ..** (24:00)

But there is a famous dictum in science that is relevant here: **Correlation isn't causation**. This means that **just because 2 things happen at the same time doesn't mean that one causes the other. ..** (24:26)

Therefore, **it would be hasty to conclude that the microbiome was causing obesity**. For that, Gordon needed to do some other experiments. He first needed to establish **that the**

connection between microbiome and obesity was also true in mice. Again, this is an interesting correlation, but not proof. .. (25:13)

First, Gordon raised ordinary mice. He also raised mice in a germ-free environment, meaning that the mice had no microorganisms in their gut. He then took gut biota from human women—specifically twins in which one twin was thin and the other was overweight. There were 3 sets of fraternal twins and one set of identical twins in his study. Gordon took samples of the intestinal microbes from the women and put them in the mice. .. (26:05)

Initially, the mice were identical—not only genetically, **but also in their weight and the rate at which they metabolized food.** But when the intestinal microbes from women were introduced to the mice, **everything changed.** (26:30)

People who retained calories and gained weight had an evolutionary advantage in caveman times, or even early in humanity's days of civilization. Heavier people not only burned calories more slowly, but **they also had some reserves in times when food was scarce**. In fact, **heavier people** were more likely **to survive famine.**

There were 3 classes of mice: sterile mice with no microbes in their gut, mice with the same intestinal microbiome as thin women, and mice with the microbiota of heavy women. Researchers found that if they fed all of the mice the same amount of food, **the sterile mice continued to metabolize as they always did. The mice with microbes from thin women gained more weight compared to the sterile mice. But the mice with the microbiome from heavy women grew quite fat. ..** (26:51)

What appears to be happening is that digestion is a more complicated process than you might've been taught, which is probably this: You chew food and the acid and movement of the stomach works on the food even more. At the end of the process, the food is split into very small nutrients that can be absorbed by the small intestines, while the larger bits that can't be absorbed move into the large intestines. ..

But **in addition to chewing** and **the chemistry of the stomach**, there is also a complicated ecosystem. **The bacteria in the stomach is also eating the food**, further reducing it. These **microbes break up more of the food** than your teeth and stomach can do on their own, which means that there are more nutrients to be absorbed by you. .. (27:51)

In this way, **2 people who eat an identical amount of food can extract a different number of calories from that food**. .. (28:00)

The picture that has been painted here is a very simple one—that if you have the right kind of microbes, you'll be thin—but the reality seems to be more complex.

If you eat a diet high in fat and low in vegetables—a typical Western diet—it seems to reduce the number of different kinds of microbes in the gut. This might be a case where the microbes that efficiently consume food simply out-compete the healthier microbes, or it could be that the fats somehow make the environment less congenial to many microbes. (28:35)

Studies in humans are still new, but they are painting a similar picture. Researchers used genetic sequencing techniques on the feces of thin and obese people to find out what kinds of microorganisms were in these 2 classes of people. **They found that heavy people had more bacteria from the phylum Firmicutes and nearly 90% less Bacteroidetes than thin people**. Furthermore, when people **lost weight, they had a much smaller number of Firmicutes and many more Bacteroidetes than they had before, but they never matched the naturally thin people. ..** (29:08)

There are now many gut biome studies, and they look very promising. This branch of research is past the stage where it could be an accidental positive result. ..

But it's still new. Medical researchers are still working out cause and effect and determining just how much impact the microbiome has on human metabolism. It's an emerging field, and more studies will lead to an improved understanding of the entire microbiome situation. (31:02)

> The Idea that obesity can be caused in part by the existence of more efficient microbes inside a person is exciting and interesting. It could revolutionize human health in the next century. (31:18)

The **Firmicutes** (Latin: *firmus*, strong, and *cutis*, skin, referring to the cell wall) are a phylum of bacteria, most of which have gram-positive cell wall structure.[3] A few, however, such as *Megasphaera*, *Pectinatus*, *Selenomonas* and *Zymophilus*, have a porous pseudo-outer membrane that causes them to stain gram-negative. Scientists once classified the Firmicutes to include all gram-positive bacteria, but have recently defined them to be of a core group of related forms called the low-G+C group, in contrast to the Actinobacteria. They have round cells, called cocci (singular coccus), or rod-like forms (bacillus).

Many Firmicutes produce endospores, which are resistant to desiccation and can survive extreme conditions. They are found in various environments, and the group includes some notable pathogens. Those in one family, the heliobacteria, produce energy through anoxygenic photosynthesis. Firmicutes play an important role in beer, wine, and cider spoilage.

Bacteroides is a genus of Gram-negative, obligate anaerobic bacteria. *Bacteroides* species are non endospore-forming bacilli, and may be either motile or nonmotile, depending on the species.[3] The DNA base composition is 40–48% GC. Unusual in bacterial organisms, *Bacteroides* membranes contain sphingolipids. They also contain meso-diaminopimelic acid in their peptidoglycan layer.

Bacteroides species are normally mutualistic, making up the most substantial portion of the mammalian gastrointestinal microbiota,[4] where they play a fundamental role in processing of complex molecules to simpler ones in the host intestine.[5][6][7] As many as 10^{10}–10^{11} cells per gram of human feces have been reported.[8] They can use simple sugars when available; however, the main sources of energy for *Bacteroides* species in the gut are complex host-derived and plant glycans.[9] Studies indicate that long-term diet is strongly associated with the gut microbiome composition—those who eat plenty of protein and animal fats have predominantly *Bacteroides* bacteria, while for those who consume more carbohydrates the *Prevotella* species dominate.[10]

One of the most important clinically is *Bacteroides fragilis*.

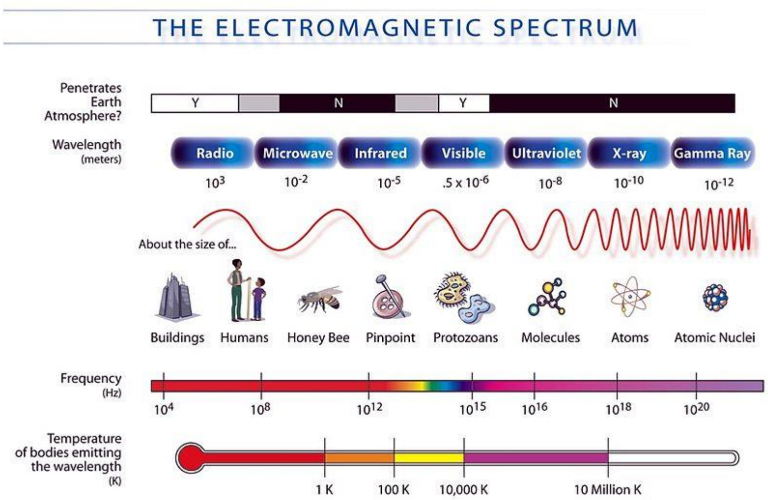
Bacteroides melaninogenicus has recently been reclassified and split into *Prevotella melaninogenica* and *Prevotella intermedia*.[11]

Presentation 10 Summer Session July 28

Exposing the truth about radiation:

TYPES OF RADIATION ..

The word radiation comes from Latin and basically means the emission of something. (2:20) It can also mean to diverge from a center. And because of that, the word can be used in ambiguous ways. For example, there is electromagnetic radiation, such as the light from a light bulb; the signal from a radio station; and the heat emitted from a warm bed. These are all types of radiation. ..(2:23)

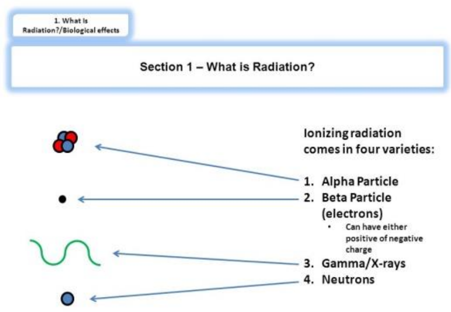


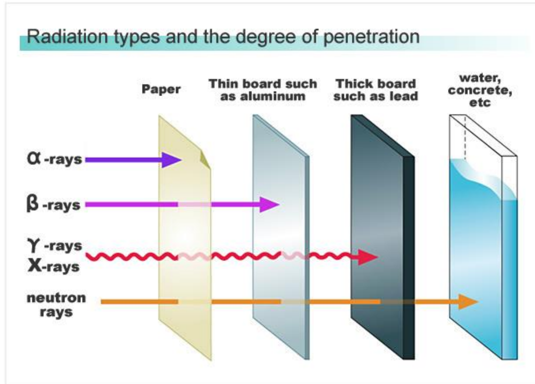
Ionizing radiation is the variety that can knock off electrons from atoms. That kind of radiation can make free radicals, which are atoms knocked off from molecules in a state that likes to bind to whatever it encounters. That can damage cells and cause health issues. .(3:04)

Types of Radiation

Ionizing radiation usually originates inside the nucleus of an atom. The energy that holds together the nucleus of atoms is generally 100,000 or 1 million times higher than the energy that holds together atoms, so when nuclear radiation is emitted, it is of higher energy and therefore more dangerous. .. (3:27)

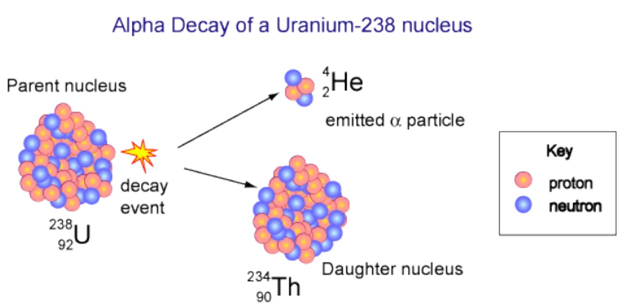
There are 4 main types of ionizing radiation: alpha, beta, gamma, and neutron. Each of them has different characteristics and affect matter differently. ..





In ionizing radioactive decay, something inside an atomic nucleus changes. The nucleus can split. That's called nuclear fission, and that is pretty rare except inside nuclear reactors. The one kind of spontaneous fission that is fairly common is when a heavy nucleus spits out an alpha particle—which is the nucleus of a helium atom.(4:15)

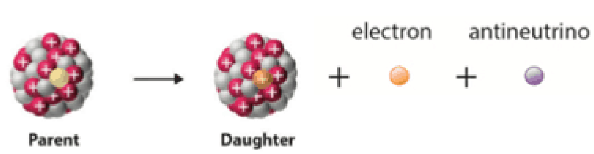
A picture of a Uranium atom decaying into Thorium



This means a bound state of 2 protons and 2 neutrons, which means that the remaining nucleus has 2 fewer protons and neutrons and therefore the daughter nucleus has changed into a different element. That's alpha radiation. Alpha emitters tend to be heavier elements, such as radium, radon, uranium, and thorium. . (4:29).

In beta radiation, a neutron in the nucleus of an atom changes into a proton, an electron, and an undetectable neutrino. The proton stays inside the nucleus, but the electron escapes. These escaping electrons are called beta particles. Nuclei-emitting beta radiation can be heavy or light; some examples are tritium, carbon-14, and strontium-90. (4:57)

Beta decay of atom into atom and Beta electron and antineutrino.

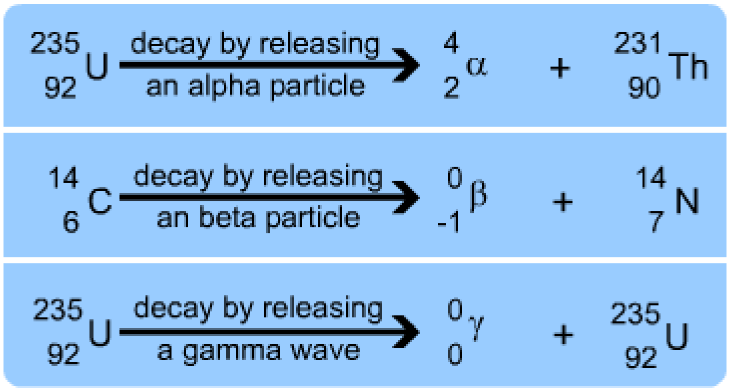


$$^{A}_{Z}X \rightarrow {}_{Z+1}^{A}Y + \beta^{-} + \bar{\nu}_e$$

Radiation

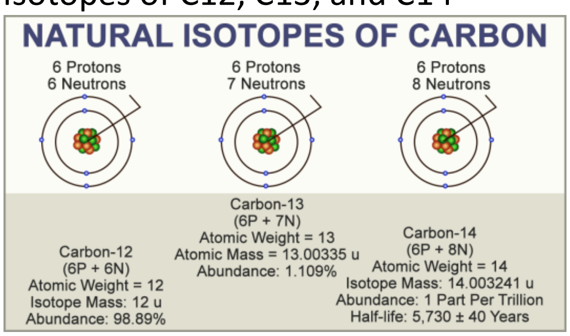
Gamma radiation occurs when an atomic nucleus emits a highly energetic photon, which is basically a bigger and more dangerous cousin of x-rays. Both gamma rays and x-rays are electromagnetic radiation, but they are of high enough energy that they can ionize atoms, with gamma rays doing it easily and x-rays having more trouble. When a nucleus emits a gamma ray, the nucleus doesn't change what element it is. Some nuclei that emit gamma rays are iodine-131, cesium-137, cobalt-60, and radium-226. .. (5:30)

Alpha emission picture , Beta Emission, and Gamma Radiation



In neutron radiation, the nucleus of an atom emits a neutron. Because the number of protons doesn't change, the element doesn't change; rather, it changes into a different isotope of the same element. For example, carbon-14 could emit a neutron and become carbon-13 (it doesn't really do that; carbon-14 decays via beta radiation). Most neutron emitters are very heavy elements, or they are a combination of 2 elements. (6:22)

Isotopes of C12, C13, and C14



These types of radiation interact with matter in vastly different ways and pose markedly different dangers to people. ..

The alpha particle is slow and heavy and has a large electrical charge, which means that it interacts very strongly as it passes through matter. Combined with its low velocity, alpha radiation is stopped very easily. In fact, you can stop alpha emission with a sheet of paper, and it doesn't penetrate the skin. It can be dangerous if inhaled, though. .. (7:27)

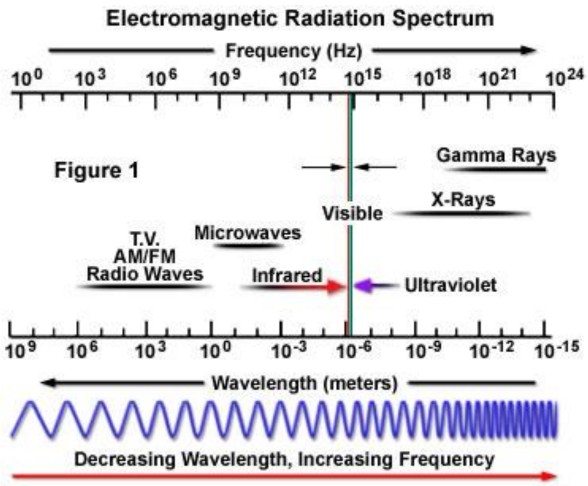
Beta radiation is the emission of electrons. Electrons are about 8000 times lower in mass than alpha particles, which means that for the same amount of energy, they are moving much, much faster. In addition, they have 1/2 the electrical charge, which means they interact less with matter. Accordingly, they can penetrate much more deeply than alpha particles can. To stop a higher-energy beta particle can take a few layers of aluminum foil. But because beta particles are emitted simultaneously with neutrinos, the energy of beta particles is often pretty low, and lower-energy beta particles penetrate even less. In fact, even ordinary cloth will provide at least some protection against beta radiation. .. (8:40)

Gamma radiation is more dangerous. Gamma particles are high-energy photons, which means they move very quickly and have no electrical charge. Accordingly, they can penetrate fairly deeply into matter. They can travel several feet in air and several inches into people. However, they are also blocked fairly easily by a thin layer of lead. (9:06)

Alpha, beta, and gamma radiation all stop in a material by either interacting with the electrons of the atoms they pass by or the electric field that holds the electrons in. By doing so, they can knock electrons out of the atoms in a process called ionization. This is the reason these kinds of radiation are called ionizing radiation. (9:44)

Neutron radiation is different. Neutrons are pretty heavy. They're 1/4 as massive as the alpha particle and about 2000 times heavier than the beta particle. And they have no electrical charge, so they don't interact by bouncing into electrons. Instead, they plow through matter until they finally hit the nucleus of an atom. Atomic nuclei only occupy about a trillionth of the volume of ordinary matter, so neutrons can penetrate very far. Because they have no charge, they don't ionize directly, but they can knock a proton out of a nucleus, and that proton can ionize. Further, when they hit a nucleus of an atom, they can convert it into a radioactive form of that element. If neutrons hit high-mass nuclei, the neutrons just bounce off, but if they hit low-mass nuclei, the neutrons lose energy and slow down. That means to shield yourself from neutrons, you should use materials that have a large number of low-mass nuclei. Examples are water, plastics, and waxes. .. (11:00)

There is also nonionizing radiation, such as microwaves, radio waves, laser light, and ultraviolet light. Those are very different from the ionizing types, with different effects. Microwaves, radio waves, and cell phone radiation are very low in energy and can only hurt you if the intensity is turned way up. Ultraviolet (UV) radiation is high enough in energy to do damage to atomic bonds. You can use sunscreen to protect your skin from UV radiation. .. (13:01)



It is unlikely that you will ever encounter any significant radiation in your lifetime.

In terms of radiation, cell phones are completely safe, in spite of what you might have heard in the seamier areas of the internet.

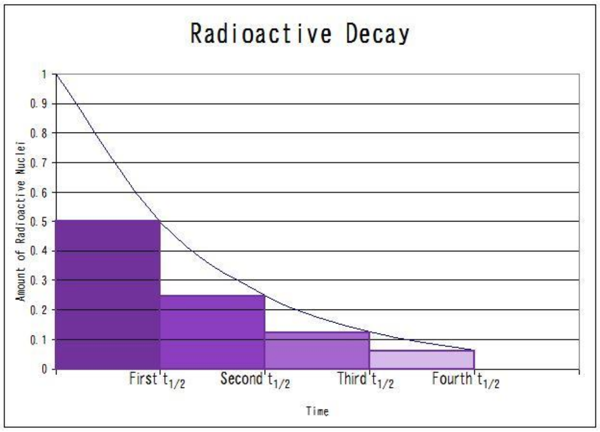
Radioactive Half- Life(13:30)

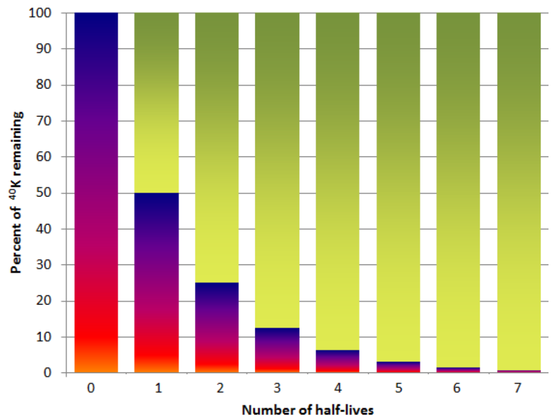
The amount of radiation in a substance changes over time. ..
Suppose that you have 100 radioactive nuclei (which, in reality, is a ridiculously small number). Actually, the nuclei are not radioactive in the beginning. They're just sitting there, doing nothing. The actual act of being radioactive is the moment when they shoot off a particle and then the nucleus changes its identity into a different nucleus. .. (13:58)

Another type of demonstration of this might be:
Take 100 pennies, place them in a small box with a lid. Shake the box. Open the ox and look inside. Remove all the pennies that are " Heads". On the next phase, time the process, from the placing the lid back on, shaking the box, and removing the " Heads" pennies and placing the lid back on the box. If we did this for ALL the phases of this process. And averaged them we could get a sense of Half-Life. Yes I know each time the process quickens but it's a model. This demonstrates the problems with models.
Back to the Lecture:

Each nucleus has a certain probability to decay in any particular amount of time. Some do and some don't. It's an entirely random process. If you wait long enough, there will be a time that 1/2 of them have decayed, leaving you with 50 undecayed nuclei. The amount of time it takes for 1/2 of the nuclei to decay is called the half-life, and the amount of time it takes for this to happen depends on the substance. Some elements decay over fractions of a second, while others can take minutes, days, weeks, months, years, or even billions of years. .. (14:39)

So, after one half-life, you still have 50 nuclei that haven't decayed yet. If you wait another half-life, you'll find that 1/2 of the remainder have decayed and the other 25 haven't. Wait another half-life and you'll find that 12.5 remain. (You can't have 1/2 a decayed nucleus, so maybe it's 12 or 13.) But the bottom line is that the amount left drops by 1/2 for each half-life. (15:03)



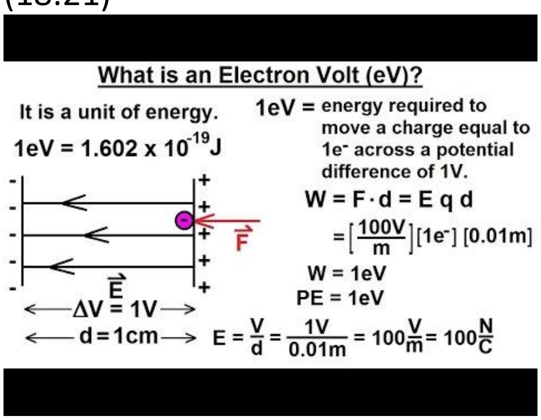


If you have equal amounts of radioactive material, the one with the short half-life will have more decays in a short amount of time and hence be more dangerous. (16:56)

RADIATION DOSES .. (17:11)

Different types of radiation have different levels of energy and different biological consequences. .. (17:34)

Even if you restrict yourself to a certain amount of radiation, not all elements emit the same energy. For example, in gamma rays, thallium-208 emits a gamma ray with 2.6 million electron volts of energy. In contrast, uranium-235 emits a gamma ray with 0.2 million electron volts. This means that gamma radiation from thallium is 13 times more energetic than uranium. .. (18:21)

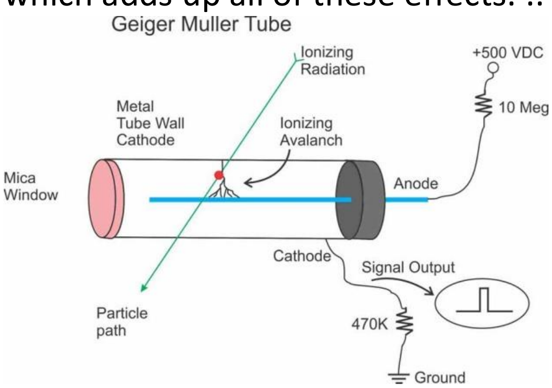


If you were trying to calculate the radiation dose you'd receive in a certain amount of time, you'd need to know how big the chunk of radioactive material is, because a bigger chunk simply has more atoms to decay. (18:52)

You'd have to know what the half-life of the element is, because if it was just a few minutes, you'd get many more decays per second than if the half-life were 5000 years. Finally, you'd need to know what the energy of the radiation is, And if you wanted to know where the radiation was deposited, you'd need to know what type it was, with alpha particles stopping on the surface and neutrons penetrating deeply. (18:53)

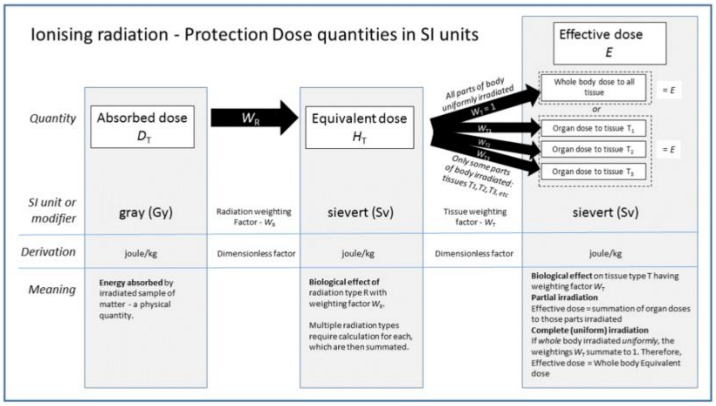
Because of the Fukushima disaster, is it dangerous to eat fish caught off the coast of California? It is true that scientists have detected unmistakable and irrefutable evidence of radioactivity from the Fukushima disaster in coastal California waters. But scientists have outrageously sensitive detectors that can monitor extremely tiny doses, and the levels are, ounce for ounce, less than the radioactivity of bananas But the levels are, ounce for ounce, less than the radioactivity of bananas. In general, seafood caught off the West Coast of the US is safe.

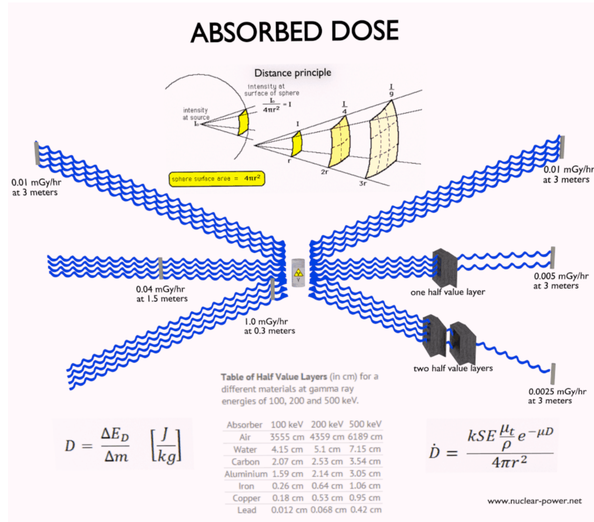
A Geiger counter can measure the amount of energy deposited in the instrument per hour, which adds up all of these effects. ..



There are 2 units that are commonly used for measuring absorbed energy: **the Gray**, which is equal to 1 joule of absorbed energy per kilogram and is the proper metric unit; (19:27) and an older unit called the radiation absorbed dose (Rad). Rads are commonly used, but strongly discouraged.

1 gray = 100 rad(19:40)
1 rad = 0.01 gray

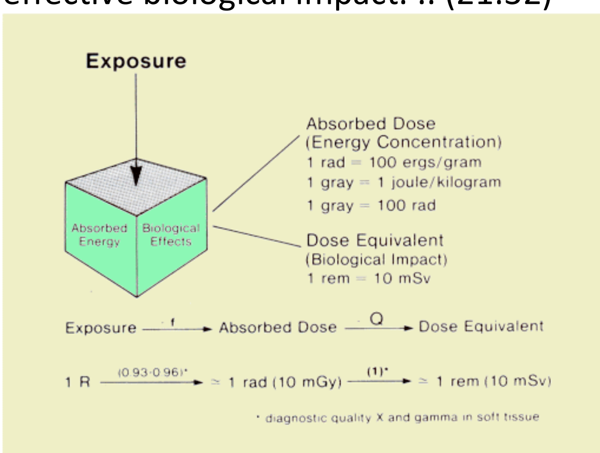




After the Fukushima disaster, the Japanese Nuclear Regulation Authority sent robots that were built to work in a radioactive environment to the nuclear reactors, and the radiation destroyed the robots in short order.

Not all types of radiation are the same when it comes to biological damage. Some do a great deal of damage and have a much more dangerous effect on your health than others. It turns out that beta radiation and gamma radiation are, particle for particle, less dangerous than alpha radiation. (20:18)Neutrons do intermediate damage. ..

Because each type of radiation has a different biological impact, different units are used that take into account each type of radiation's relative damaging ability. The relative damage is called the quality factor (Q), and the rad or gray number can be multiplied by Q to get the effective biological impact. .. (21:32)



The radiation dose unit that corresponds to Rads is the **Rem** (an acronym for Roentgen equivalent man) while the unit corresponding to Grays is the **Sievert.** (22:25)

100 rems = 1 Sievert (22:33)

Rem = Q × rad

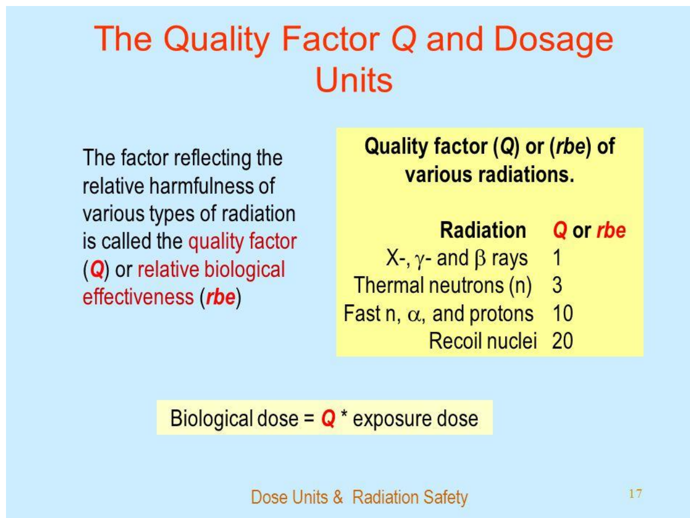
Sievert = Q × gray

Radon from homes is the biggest source of naturally occurring radiation, and cosmic rays from space are the second.

The following table shows Q factors for the various types of radiation. Beta, gamma, and x-ray radiation all have the same ability to damage, and the effective damage of other types of radiation are compared relative to those. In contrast, slow neutrons do 5 times as much damage for the same amount of deposited energy, and fast neutrons do 10 times. Finally, the very damaging alpha particles do 20 times as much damage as the betas and gammas. (23:22)

Type of Radiation	Q Factor	Type of Radiation	Q Factor
Beta	1	Slow neutron	5
Gamma	1	Fast neutron	10
X-ray	1	Alpha	20

Body Part	Q-Factor	Dose Equivalent
Bladder	25	0.04
Bone Marrow	8.33	0.12
Bone Surface	100	0.01
Brain	100	0.01
Breasts	8.33	0.12
Colon	8.33	0.12
Esophagus	25	0.04
Gonads	12.5	0.08
Liver	25	0.04
Lungs	8.33	0.12
Salivary Glands	100	0.01
Skin	100	0.01
Stomach	8.33	0.12
Thyroid	25	0.04
Rest of the body	8.33	0.12
Total		**1.00**



RADIATION IN THE REAL WORLD (23:34)

Consequence Dose, relative to the normal Normal living in society (annual) 1 Whole-body CT scan 2 Total annual allowed dose for radiation worker 8 Annual dose with a small increase in cancer risk 16 Radiation sickness (quick dose) 64 Radiation poisoning (quick dose) 320 Frequently fatal (quick dose) 640 Always fatal (quick dose) 1300

Radiation in the Real World

Consequence	Dose, relative to the normal
Normal living in society	1
Whole-body CT scan	2
Total annual allowed dose for a radiation worker	8
Annual dose with a small increase in cancer risk	16
Radiation sickness (quick dose)	64
Radiation poisoning (quick dose)	320
Frequently Fatal (quick dose)	640
Always Fatal (quick Dose)	1300

(27:06)

The Chernobyl nuclear Disaster (28:17)
Released 8000 time the dose received in one year(28:36)
The Fukushia Disaster – living in the nearby town you could receive 30 mS/year. (29:27)
In the town for 12 hours you would receive approximately 0.04 mS/visit (29:52)
Eating Fish off the coast of California.
Tuna should be the most radioactive of fishes.. the radiation of these fishes is less than that of a banana (31:33)
Radon Gases are found in the northern latitudes of the US.

Readings
Gale ad Lax, Radiation
Jorgensen, Strange Glow