

Aiming to First, Do No Harm:
The Education of Electronics Users
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Would everyone please turn off their cell phones? Is there anyone here who can't do that or does not know how to do so?

I am truly glad to be here tonight. Thank you to Colorado Chautauqua for inviting me. And thanks to everyone for coming.

When I began writing *An Electronic Silent Spring*, I wanted one chapter to describe how electricity gets to a breaker box and how wireless devices work. I read physics textbooks and electricians' manuals and sent my chapter to three physicists. Each man declared me a genius.

Then I sent the chapter to an electrical engineer and two electricians who write trade manuals. Each of them declared me an idiot.

And so I really began to see how complicated this stuff is. Electrical power is necessary, invisible and barely understood. Just asking questions about it can upset people, kind of like asking about money.

A chemist read my chapter and declared it fantastic.

Then he called back the next day with second thoughts "You can't explain electricity simply," he explained, "without making grossly inaccurate statements."

I still sensed that my book would be incomplete without describing how mobile phones and Wi-Fi work. So I called Gary Olhoeft. Gary is a physicist with two degrees in electrical engineering. When I asked if he could edit my technical chapter, he'd just retired from teaching at the Colorado School of Mines. And so, this novelist who's also written about menstrual cycle health began a very unlikely tutorial.

I should clarify that even tonight, I am still trying to describe massively complex issues in simple terms in a short amount of time. Please bear with me.

My first lessons from Gary Olhoeft take us back a few billion years, before man-made laws or mobile phones, when this planet was a mass of gasses, water, dust and rock. After a buildup of charge, lightning began to strike. A *bombardment* of lightning storms led to nucleic and amino acids, the building blocks of life. Early plants made oxygen and paved the way for animals.

Plants and animals still function by electro-chemical signals. So do our brains and hearts. Even at rest, all cells have measurable voltage. In other words, without electromagnetic energy, none of us would be here.

The ancient Greeks knew how to generate electricity, but not how to store or transmit it. The Greeks also created a regulatory system for health that included the direction to *First, do no harm*.

Humans figured out how to store electrical energy around 1750. By 1880, we also knew how to transmit it over long distances. We created batteries, motors and electric lights and built things like refrigerators. We transitioned from visible, mechanical technologies powered by horse and human muscle, then steam and hydropower, to electromagnetic technologies, whose power is invisible.

By 2015, about 135 years after we began laying out an electric power grid, we have nearly saturated our environment with electrical and magnetic frequency fields and amplitudes that do not exist in nature. We've changed the Earth's electromagnetic environment more significantly than any time since humans showed up on the planet. Most of this change comes from our electric power grid and, more recently, from cell phones and Wi-Fi.

What education prepares us to live with these massive environmental changes? What regulation protects us?

I'd like to describe four generations of education and regulation around electronic technologies. The first generation starts in 1925, when Gary's father, Roy Olhoeft, was a teenager with saved money. Roy asked *his* father, Gary's grandfather, Joseph, to let him buy a car.

Joseph Olhoeft was a master car mechanic. He and Roy found a \$25 Model T Ford with a problem. Joseph instructed his son to lay every part of the car on the lawn, identify the problem and repair it. If Roy could reassemble the car and get it to drive correctly, he could have the Model T.

Sure enough, Roy found the worn out washer in the transmission.

He went on to buy wrecked sports cars and fix them up for resale. Around 1930, with a crystal radio kit, Roy assembled his family's first radio.

Actually, by the 1930s, we'd had intercontinental radio--then called "the wireless"--for several decades. We had telephones and crude televisions, refrigerators, washing machines and military radar.

In 1934, Congress established the Federal Communications Commission, the FCC. "Go forth and market electronics," the FCC proclaimed to inventors, "as long as they don't create 'harmful interference.'" The FCC defined "harmful interference" as anything that interferes with existing licensed services such as radio or TV broadcasts.

Today, this definition includes cell phone and Internet services.

At the FCC, "harmful interference" has never included biological harm--that is, health or environmental harm caused by exposure to electromagnetic radiation (EMR) emitted by electronics.

Call this exclusion of nature. Call it disregard for the regulation to First, do no harm.

The Second Generation of tech education and regulation starts around World War II, when electronic inventions flourished for the home and the military.

During the war, Roy Olhoeft served as a master sergeant, repairing P-51 Mustang Aircraft for the Army Air Corps.

The microwave oven was invented in 1945. Amana called it the RadarRange and began selling it to homemakers in 1967. Rapid development of post-war products outpaced regulation. Inventors sold vacuum cleaners, washers and dryers, shoe store x-rays to ensure a good fit, asbestos insulation, pesticides, electric toothbrushes, electric guitars and pianos, hair curlers, digital alarm clocks, electric cars and robotic surgery.

The first fully automated mobile phone system for vehicles was launched in Sweden in 1956. The first wireless computer communication network was installed in 1970 at the University of Hawaii. Email was introduced in 1972. IBM introduced its personal computer in 1981. We've got Bluetooth and Wi-Fi.

I could go on. You know the rules: as long as an invention does not interfere with existing radio, TV, cell phone or Internet services, the FCC says you can sell it.

Just before World War II, Roy Olhoeft married the assistant to the president of Goodyear Aircraft. After the war, Roy and Helen had two children; and Roy worked as the last master miller for the Quaker Oats Company. In 1966, he patented Quaker Instant Oatmeal, those breakfast packs that only require hot water. Rachel Carson's *Silent Spring*, which illuminated pesticides' harmful effects, was not published until 1962; and so before family barbeques, to get rid of mosquitoes and flies, Roy used an electric "fogger" to spray his backyard with pesticides.

Gary had a knack for taking things apart. In high school, he repaired cars and televisions. To remove the engine grease on his bare hands, he rinsed them with gasoline. In 1967, after Gary showed his father that he could repair a Ford Mustang, he had his first car.

While at MIT, where he received two degrees in electrical engineering, Gary got computers from a surplus yard, took them apart and reassembled them. NASA hired him to work on the Apollo program while he was still an undergraduate. He received a PhD in Physics from the University of Toronto, then worked for the U.S. Geological Survey for 20 years, supervising, among many other things, cleaning soil polluted by harsh chemicals. After that, for two decades, Gary taught electromagnetic exploration geophysics at the Colorado School of Mines.

Let's take a look at one electronic regulation after World War II.

In 1958, the first cardiac pacemaker was installed in a person. Almost immediately, people with these implants complained to Congress and their doctors that nearness to a microwave oven could shut off their pacemaker.

In 1971, after 13 years of complaints from diners with pacemakers, the FDA ruled that restaurants had to post notices if a microwave oven was on the other side of a wall.

In 2015, we have many more kinds of medical implants besides cardiac pacemakers. No agency tracks or regulates their use.

Interference, Gary explained to me, is any unwanted effect--like someone playing music loudly when you want to hear a phone conversation.

Electromagnetic interference is when electrical or magnetic fields produce an unwanted effect, typically at lower frequencies, by induction.

Radiofrequency interference is when electromagnetic fields produce an unwanted effect, typically at higher frequencies, by radiation.

Electromagnetic signals make devices like motors, power lines, radio, TV and cell phones work. Geophysicists might consider these same signals noise and interference, especially while they study earthquakes, environmental contamination, or infrastructure problems like corroding pipelines with extremely sensitive meters that measure changes in electromagnetic fields.

What's a desirable electromagnetic signal?

What's an unwanted noise?

The answers depend on the situation--and on your perspective.

Back to regulations after World War II. In 1969, under President Nixon, Congress formed the Environmental Protection Agency, the EPA. One division studied the effects of exposure to electromagnetic radiation.

In 1971, the President's Office of Telecommunications Policy reported that "The consequences of undervaluing or misjudging the biological effects of long-term, low-level exposure (to electromagnetic radiation emanating from radar, television, communications systems, microwave ovens, industrial heat-treatment systems and many other sources) could become a critical problem for the public health, especially if genetic effects are involved."

By 1988, the EPA had 36 full-time employees dedicated to studying the effects of EMR exposure on the public health and our environment. Under President Reagan, Congress began to cut this division's funding. While the EPA is still authorized to research EMR's effects on our health and environment, since 1995, Congress has allotted it zero funding to do so.

In the late 1970s, Roy Olhoeft bought a VHS player to watch movies on his television set. The number 12 o'clock flashed on it perpetually--because this mechanic could not figure out how to set a digital clock.

In the 1980s, I taught writing at South Boston High, the school that became famous around court-ordered desegregation of the Boston Public Schools. My students had the lowest literacy rate in Massachusetts--and the best stories I'd ever heard. One day, I made an appointment with a student who wanted to write her story. But Lillian never showed up.

The next day, I asked where she'd been at a quarter to three. Lillian shrugged. "I don't know that time," she said. "I only know digital."

This was 1986. *How on Earth*, I wondered, *would this girl survive?*

As it turned out, the cluelessness was mine.

Generation Three regarding tech education and regulation starts in 1996, the year after Congress took away the EPA's funding to study EMR's effects on health and the environment. In 1996, President Bill Clinton signed the Telecommunications Act. Section 704 mandates that

the FCC will *"prohibit state and local governments from restricting or influencing the siting of wireless antennas and towers based on environmental grounds."*

Stated plainly, no health or environmental concern may interfere with the placement of a cell tower.

Call this federal Act a great win for the telecom industry, a complete disregard of the Precautionary Principle to *First, do no harm*--and a great loss for public health and our environment.

Also in 1996, the FCC established Specific Absorption Rates--SARs. A SAR is the measure of radiofrequency radiation absorbed by the body. If a manufacturer complies with these exposure limits, then its devices are presumed safe to market.

For the head and trunk, the FCC allows a SAR of 1.6 w/kg averaged over any one gram of tissue for six minutes.

The body's extremities, such as the hands and feet, have a SAR limit of 4 w/kg averaged over any ten grams of tissue. Pregnant women, infants, children and people with medical implants have the same SAR limits as healthy adults.

Gary popped a quiz: *Which is greater: the intensity of radiation that a microwave oven is allowed to leak, or the intensity of radiation that a cell phone is allowed to emit?*

Yes. A cell phone is allowed to emit more radiation than a microwave oven is allowed to leak.

When did we begin to dismiss questions about how a new technology affects our health or the flora and fauna with whom we share this Earth?

When did we begin to focus only on technology's benefits: a way to clear mosquitoes; a way to wash grease off of hands. A way to reach someone stuck in traffic about the kind of dinner we want. What could balance technology's developments with its harmful consequences?

Since 1996, telecom corporations have rolled out infrastructure that supports higher speeds, greater bandwidth and more ubiquitous services. Federal and local governments, school boards, businesses, hospitals and individuals have purchased devices in step with this infrastructure. Gas, water and electricity providers now commonly measure every household and office building's utility usage with wireless transmitting "smart" meters.

What are the consequences of such deployment for infants in utero, for children with developing brains, for those who began using mobile devices as children, for anyone who works and sleeps in Wi-Fi and uses a cell phone? What are the consequences of using a mobile device for more than six minutes? Of living, studying or working within 100 feet of a cell tower?

What are the health and environmental effects of EMR exposure that Section 704 of the Telecommunications Act prohibits municipalities from considering?

Answers to these questions are usually divided between the thermal and non-thermal effects of exposure.

When exposure heats tissue, like it does when you put meat in a microwave oven, you have a thermal effect.

To determine whether cell phones are safe, engineers took a 200 pound mannequin--a Standard Anthropomorphic Man, called SAM. They filled SAM's head with salty fluid and took his temperature. Then they gave him a cell phone for six minutes. Because this plastic dummy's temperature did not change by two degrees within those six minutes, the FCC determined that you can safely use a mobile phone.

What are the non-thermal effects of exposure?

Before I share some of these studies--and you can find thousands of them at places like BioInitiative.org and saferemr.com--know that U.S. telecom corporations will not give their subscribers' usage data to epidemiologists. Peer-reviewed studies about EMR's biological effects come primarily from other countries and the World Health Organization.

Let me name some of these studies' findings: Man-made EMR exposure affects the rate of calcium efflux through cell membranes, melatonin production and metabolism, the brain's metabolic rate, and the rate of DNA breakage, exactly what the President's 1971 report warned could become disastrous to the public health.

Three independent, case-controlled studies find a two-to-three-fold increased risk for brain cancer from using a cell phone.

People who begin using a digital cell phone as teenagers or younger have a 420% increased risk of brain cancer.

South Korean teens now commonly have dementia. Their doctors think this comes from excessive screen time--and using only one side of their brains.

If you type "Internet addiction" into Google, you'll find over 29 million sites. "Cell phone addiction" results in four and a half million sites. Frequently now, I read about teenagers and children who become violent when their Internet privileges are taken away. I read statements from physicians who liken Internet addiction to heroin addiction.

Lots of folks just don't feel well after they get Wi-Fi or a new mobile device or their utility installs smart meters or a cell tower goes up nearby. They don't sleep. They develop headaches and memory problems, eye strain, nausea and strange rashes. Plenty of European and Russian studies since the 1960s associate these symptoms and many more with exposure to radiofrequency radiation from military radar and now mobile devices, cell towers, Wi-Fi and smart meters.

As for wildlife, a Spanish biologist studied a common frog habitat 140 meters from a cell tower. He placed metal screens--shields--around some frogs. Two months later, these shielded frogs had a mortality of 4.2%. The unshielded frogs had a mortality of 90%.

In a German study, 65% of bee colonies abandoned their hives after nearby cell towers went live. GMOs, pesticides and monocultures likely also play roles in bee colony collapse. But ill bees typically die *in* or *near* their hives. In this study--as with most cases of bee colony collapse--no ill bees were found.

To navigate, bees use cryptochromes, magnetically sensitive genes in their eyes, that can sense the Earth's electromagnetic energy fields. Exposure to EMR emitted by cell towers disrupts cryptochrome-based navigation.

Consider insurance underwriters' assessment of man-made EMR: A.M. Best and Lloyds of London advise insurance companies not to ensure against damages to health caused by wireless devices. Swiss RE rates exposure to man-made electromagnetic fields higher than any other emerging risk, including fracking, GMOs and the re-emergence of asbestos.

In 1996, the year that Congress passed the Telecommunications Act, and a year after Congress stopped funding the EPA to study EMR exposure's effects on our health and environment, Gary Olhoeft was diagnosed with Parkinson's. This neurodegenerative disease associated with several likely causes, including exposure to pesticides like those Roy Olhoeft sprayed in the family's yard, and solvents like gasoline, which Gary used to wash his hands.

For 13 years, to contain symptoms, Gary took pharmaceuticals. Eventually, the medicines' side effects created more problems than the Parkinson's. He considered getting a deep brain stimulator--a DBS. He was especially concerned about how other electronics might interfere with such a medical implant, but he knew of no better alternative.

Generation 4 for Gary's tech education and regulation starts in 2009, when he acquired a deep brain stimulator. The DBS includes a battery powered pacemaker in Gary's chest, near his heart, eight 24" wires bundled into a cable that runs from the pacemaker up through his neck, over the top of his head and down to electrodes inside his brain behind his eyes.

After Gary's surgery, Medtronic--the implant's manufacturer--published an extensive list of electronic devices that may interfere with a deep brain stimulator. Besides lessening the symptoms of Parkinson's, a DBS works as an antenna. Of course, any metal object can act as an antenna, though it won't be efficient unless it's designed to work like one.

Gary learned that to keep his implant functioning properly, he needs to keep his head and body at least 20 inches from cell phones and other mobile devices. Closer proximity can reprogram or shut the implant off. Some exposures can heat the wires in his brain; such heat could damage his brain or cause his death.

Electronics became Gary's savior and his bane. He realized that walking through theft detectors at a mall or the public library can shut off his DBS. Metal detectors at airports and government offices, MRI diagnostics, surgical electrocautery tools and many electric and hybrid cars can also reprogram or shut off his implant. When this happens, has seconds to reset it--or he shakes so badly that he can't reset it without help.

At the start of each school year, School of Mines geophysics faculty gather at a retreat center on Lookout Mountain. This mountain also houses TV, radio and cell phone service antennas for the Denver area. Gary realized that being at the Lookout Mountain retreat for more than 90 seconds could heat the wires in his implant and damage his brain.

If you're thanking your lucky stars that you don't have a DBS or a cardiac pacemaker or an insulin pump or a cochlear implant, consider your dental work: a metal crown or tooth filling can also work as a radio receiver.

Gary doesn't live far from here, but he could not attend this talk because, like many parks, Colorado Chautauqua has Wi-Fi, and we could not predict how many cell phones would be in the audience. The combination of Wi-Fi and an auditorium full of cell phones could reprogram his deep brain stimulator or shut it off.

In year 2000, NIH estimated that 8 - 10% of the American population had some kind of medical implant. Besides cardiac pacemakers and neurostimulators, insulin pumps and cochlear implants are increasingly common. In 2013, President Obama committed \$100 million to expanding use of deep brain stimulators for people with pain, depression and obsessive compulsive disorders.

Consider the implications: I've known people whose insulin pumps shut off when they're in a crowd of cell phone users. I know of a man whose cardiac pacemaker kept malfunctioning when "smart" meters were installed in his neighborhood. The pacemaker didn't function properly until analog meters were restored to his home *and* his neighbors' homes.

I know of a man who had a cardiac pacemaker and a deep brain stimulator. Then, he got a cochlear implant. The signals from these implants interfered with each other, causing this man--who happens to be an MD--tremendous discomfort. His surgeons suggested repairing his home's electrical system. They did not believe that implants could interfere with each other. They can.

I know a diabetic who was hospitalized for ketoacidosis, excess blood acids. Her blood pressure did not normalize until the wireless heart monitor clipped to her robe was removed and replaced with a corded one.

I'm not saying that the wireless monitor kept her sick. I'm saying that we need to take a pause: No new deployment of an EMR-emitting device until it is proven harmless for pregnant women, infants, children, people with medical implants, 200 pound males and bee colonies--whether exposure lasts for a few seconds per day or continues 24/7.

We also need a regulatory environment that protects our health and ecosystem.

I'm especially concerned about the risks of EMR exposure to children. In 2014, Dr. Hugh Taylor, the head of Yale Medical School's ob/gyn department, warned pregnant women and children that exposure to cell phone and Wi-Fi radiation may increase aggressive behavior in children.

After schools install or upgrade their Wi-Fi, parents and teachers report that some children begin bleeding from their noses and ears. Some go on beta-blockers for high blood pressure. Some get strange rashes and become constantly nauseous. In a Canadian school district, several teenagers had heart attacks. Rather than eliminate the Wi-Fi, this school district installed defibrillators, as if teenaged heart attacks are normal.

Other countries have are taking proactive measures: The Israeli Supreme Court is considering banning Wi-Fi in schools.

To address its 24 million Internet-addicts under 18, China has established 250 military-style boot camps.

To prevent addictive behavior and support developing brains, the Taiwanese government will fine anyone who exposes children under two to television, an iPad or any other device with a screen \$2000.

In 2013, the FCC requested Comments from the public about its proposed revisions to telecom regulations. The EMR Policy Institute, with which Gary Olhoeft and I are affiliated, submitted a definition of biological harm: "Harmful interference," we wrote, "includes acute, chronic or prolonged exposure to RF signals and emissions that endangers, degrades, obstructs or repeatedly interrupts biological functioning of a person, plant, animal or ecosystem, or that results in adverse health effects from malfunctioning of medical devices."

We proposed that the FCC include this in its definition of "harmful interference." The FCC has never responded to our proposal.

Instead, in September, 2013, this engineering agency reclassified the outer parts of our ears as extremities. A few minutes ago, I explained that hands and feet are extremities, legally able to receive a Specific Absorption Rate of 4.0 w/kg within one gram of tissue, nearly three times as much radiation as the head and trunk are allowed.

Now that the FCC considers your outer ears as extremities, they can legally absorb the same amount of radiation as your hands and feet. The ears of pregnant women, infants, children and people with medical implants can now also receive nearly three times as much radiation--and manufacturers can sell us much more powerful devices.

In 2014, Boston area Starbucks began deploying wireless charging stations in their coffee shops. McDonalds began deploying them in UK.

Gary Olhoeft contacted the Wireless Power Consortium and asked whether their wireless chargers would interfere with his deep brain stimulator. An administrator told him that the chargers work by magnetic induction.

This raises more red flags. Magnetic induction used by some stovetops can emit magnetic fields into the hundreds of milligauss. With chronic exposure, magnetic fields in the 2-5 milligauss range present a risk for cancers and neurological diseases. The World Health Organization declared magnetic fields a possible human carcinogen in 2001; it declared radiofrequency field radiation--which cell phones and Wi-Fi emit--a possible carcinogen in 2011.

Don't manufacturers need to analyze their products' risks to the public? What would be the consequences of seating a small child in a metal-sided stroller at a table with a wireless charger? Shouldn't the public be informed and warned about the consequences before sitting near a charger?

"Let me be specific," Gary Olhoeft emailed. "How close can I get to the wireless charging system? Could Starbucks doors post signs to warn people with medical implants about the EMR emissions inside? At what distance does the wireless power exceed 0.1 milliTesla, the maximum recommended exposure for people with medical implants?"

While this discussion evolved, IKEA announced that it will market furniture with embedded wireless chargers beginning in April, 2015.

"They'll be in hotels," Gary realized. His access to areas of public accommodation will likely become even more limited.

Gary is now testing wireless chargers. He's found that some manuals warn people with cardiac pacemakers to keep at least nine inches from the charger. Some chargers--sold inexpensively on Amazon--claim FCC certification but do not appear in the FCC database of approved devices. And don't leave your purse near a wireless charger. It can erase the magnetic strip on a credit card or a camera. It can magnetize Rolex watch parts so the watch will not work.

And there we have less than two centuries of electronic developments on planet Earth.

Please be aware. For most of us, the days of using tools we can repair are over. More than ever, we need regulators who protect the public health. But EPA, OSHA, FDA, FCC and NTIA each have piecemeal authority and inadequate funding at best. Every person is woefully on their own in conducting research and limiting their EMR exposure.

Please: reconsider before you upgrade a device or a service. Inform pregnant women about the dangers of cell phone use and Wi-Fi. Reconsider before you use a mobile device in a car, train, plane, elevator or public space. Don't download pictures or videos wirelessly. Get corded landlines restored. Turn Wi-Fi off every night for at least 12 hours until you get wired Internet access. Eliminate fluorescent lights and dimmer switches, which both put radiofrequency noise on 60 Hz wires. If you've got a transmitting utility meter on your home, get an analog one restored.

If you live in a community that recognizes that wireless devices can harm living creatures, consider a Community Rights ordinance, the kind that have been used in over 200 municipalities around the world to prevent fracking, GMOs, pesticides, industrial animal factories, and corporate ownership of public utilities. Community Rights ordinances nullify laws like the Telecommunications Act's Section 704, which specifically removes our inherent right to self-governance. You can learn more about Community Rights at www.democracymepark.org and www.paulcienfuegos.com.

By all means, inform your family, friends, neighbors, physicians, teachers and Congressional representatives about electronic interference and the biological effects of EMR exposure.

By the way, Gary doesn't consider me a genius or an idiot. He calls me a troublemaker, which he defines as someone who asks questions and suggests we take a pause. He considers himself a troublemaker.

Does anyone here identify as a troublemaker?
Would you stand up?
Thank you very much.