Healthy Schools
A Call for Best Practices with Wireless Radiation from Authorities Across the World

(Preliminary Report 8/1/2014)

This document describes concerns raised by scientists concerning wireless radiation and children's health and the policy actions taken by international authorities to reduce the risk.

"Even though the radio frequencies that are emitted from current cell phone technologies are very weak they are able to activate the human brain."
-**Nora D. Volkow, M.D.,**
Director of the National Institute on Drug Abuse at the National Institutes of Health

"Three years ago the World Health Organization declared cellphone and other wireless radiation to be a possible human carcinogen, the same category as some pesticides, lead and engine exhausts. Since then evidence has mounted that such radiation can profoundly affect human biology, altering brain metabolism, damaging animals exposed during pregnancy and reducing sperm count. Before blanketing our preschools, kindergartens and middle schools with wireless radiation we need a full life-cycle assessment of economic and health costs and benefits of wireless technology."
- Devra Davis PhD MPH, President of the Environmental Health Trust,
in her Open Letter to President Obama April 2014

Note: This online document serves as a portal to a wealth of online sources and research. Blue underlined text is hyperlinked to sources/ informative web pages.

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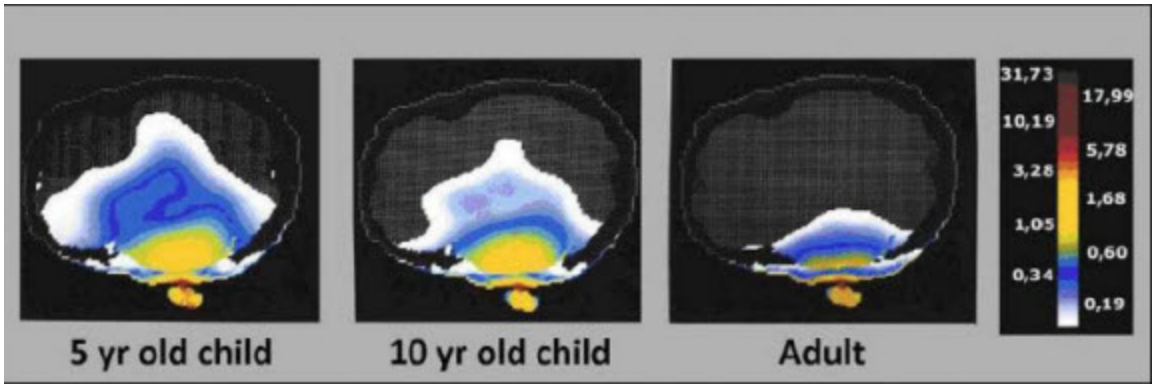
Children's Unique Vulnerabilities to Wireless Radiation



(Om P. Gandhi et al., 2012)

The image above demonstrates the increased absorption of wireless radiation within the brains of children compared to adults. WIFI radiation has *never* been evaluated for its long term impact on the developing brain. Recent research is linking wireless with serious potential health effects.

"*Children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. In fact, according to the International Agency for the Research on Cancer, when used by children, the average RF (radiofrequency) energy deposition is two times higher in the brain and 10 times higher in the bone marrow of the skull, compared with mobile phone use by adults…it is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes.*"
– Dr. Robert Block, President of the American Academy of Pediatrics, 2012.

Why are Children and the Developing Fetus More Vulnerable?

- Children have smaller heads with a shorter distance to brain centers.
- Children's skulls and ears are thinner allowing radiation to penetrate further.
- Children's brains contain more fluid and absorb more microwave radiation.

"My heart, head, and all my instincts, my education in science and my past experiences as teacher and parent of young children tell me that we should not subject children to microwave radiation unless for a very good medical reason. ...This is not the first environmental threat to children's welfare but it is probably the biggest one yet." **-Peter Limbrick, Team Around the Child, 2/2014 Editor's Open Letter**

Environmental exposures at critical periods can have profound effects on fetal and childhood development.

- Children's nervous systems and immune systems are developing at a rapid rate.
- Brains are maturing through the early twenties.
- Children have more active stem cells which are shown to be more impacted by microwave radiation.

"As a research scientist and physician who studies how microwave radiation affects the outcomes of pregnancy, I am deeply concerned about growing exposures to cell phone and other wireless radiation."
- Dr. Hugh Taylor, Chief of Obstetrics at Yale Medical School, 2013.

Health Risks

Wi-Fi is low level microwave radiation. Many published studies over the past 20 years have shown an array of serious biological effects. DNA damage and disruption of the blood brain barrier (BBB) have occurred at levels hundreds of times lower than US exposure limits. In this section we provide an overview of some health issues related to wireless radiation. Selections of research on each health issue are detailed at the end of this document.

Reproductive Impacts: Consistent evidence from experimental research, epidemiological studies and in vitro (cells) laboratory, and in vivo (animal) studies shows that RF exposure is associated with reduced sperm count, motility and concentration, as well as DNA damage and altered cell structure. Some research also shows damage to the ovaries of rats and mice and changes in the eggs of flies and birds.

> "The epidemiological studies of men assessed for infertility were consistent in demonstrating decreased sperm motility associated with increased use of mobile phones" and "biological effects on sperm motility related to RF exposure". - **The BC Center for Disease Control 2013 Report, *A Radiofrequency Toolkit for Environmental Health Practitioners.***

Cancer: Research showing that long term heavy cell phone users have an increased risk of brain cancer lead to the WHO IARC classification of this radiation as a Class 2 B carcinogen: a "possible human carcinogen". A study showed that adults who started using cell or cordless phones as teenagers had a 8-fold higher risk of brain cancer on the side of their head where they held the phone. To date, the only published study of children's' risk of brain cancer from cell phone use found more than a 2-fold risk after >2.8 years of use (from billing records), combined with a statistically significant trend of increasing risk with increasing year of use.

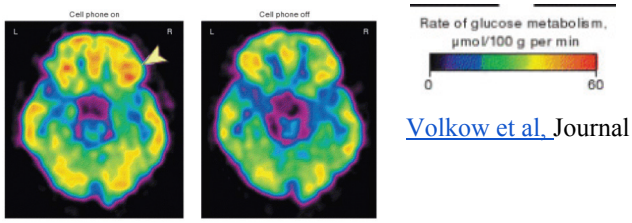
Hearing: Research shows chronic mobile phone usage results in high frequency hearing loss and inner ear damage . Research has also shown significant risk of tumors on the auditory nerve in the brain (acoustic neuromas).

Disruptions to Heart Functioning : Some research shows increases in heart rate, arrhythmias, dizziness, changes in blood pressure and other disturbances in heart functioning from wireless radiation.

> *"A disservice has been done in inaccurately depicting the body of science, which actually indicates that there are biological effects from the radiation emitted by wireless devices, including damage to DNA, and evidence for increased risk of cancer and other substantial health consequences…The public the world over has been misled by this reporting."*
> **Dr. Ronald B. Herberman, Founding Director of the University of Pittsburgh Cancer Institute, Vice Chancellor of Cancer Research at University of Pittsburgh and the first head of an NCI funded cancer center to speak out on the risks from cell phones.**

Headaches: Research shows children who used cell phones or were exposed prenatally to wireless radiation are at higher risk of developing headaches.

Neurotoxic effects: Experimental research shows chronic exposure kills and reduces brain cells. 2011 NIH research found just 50 minutes of a wireless transmitting device (cell phone) next to the brain increases glucose in the part of the brain most exposed. Preliminary 3G and 4G research has shown shown that non-thermal levels of this radiation alter the brain's electrical activity.



Volkow et al, Journal of the American Medical Association, 2011

Cognition and Impaired Memory: Recent research at Yale University found prenatally exposed pups had impaired memory, increased hyperactivity and altered brains- consistent with a growing literature.

"We have shown that behavioral problems in mice that resemble ADHD are caused by cell phone exposure in the womb," said **Dr. Hugh Taylor of Yale Medical School**. "The rise in behavioral disorders in human children may be in part due to fetal cellular telephone irradiation exposure."

Behavioral Issues: Epidemiological studies have shown associations between exposures and behavioral issues in children. For example, a recent study showed a significant dose-response relationship between the number and duration of voice calls made on cell phones and ADHD risk among children exposed to lead in their environment.

Microwave from wireless tech disrupts thinking – what could be worse for learning? Technology can be used more safely with wired devices that do not produce these biologically-disruptive levels of microwave radiation" said Cindy Sage, Co-Editor of the BioInitiative Report, a comprehensive report written by 29 international experts on the current scientific evidence on electromagnetic fields. The Report recommends wired access without WiFi whenever possible.

Sleep: Research shows this radiation from wireless transmitting devices can impact sleep. For example, this radiation has been shown to delay entrance into deep non-REM sleep and decrease time spent in this stage of sleep. The quantity and quality of sleep has a profound impact on learning and memory. A sleep-deprived person cannot focus or learn efficiently. Sleep also has a critical role in the consolidation of memory essential for learning new information.

"Radiation at extremely low levels (0.0001 the level emitted by the average digital cellular telephone) caused heart attacks and the deaths of some chicken embryos...independent, third-party peer-reviewed studies need to be conducted in the U.S. to begin examining the effects from radiation on migratory birds and other trust species."
-Willie Taylor, US Department of the Interior in his February 2014 letter to Mr. Eli Veenendaal of the National Telecommunications and Information Administration, U.S. Dept. of Commerce.

Oxidative stress: Oxidative stress is the formation of tissue-damaging free radicals. Significant research shows wireless radiation increases oxidative stress which damages cells and their DNA through the production of peroxides and free radicals. Oxidative stress is implicated in the cause of many diseases such as cancer and Alzheimer's disease.

Genotoxic effects: Studies at non-thermal (no measurable temperature change) levels of microwave exposures show chromosomal instability, altered gene expression, gene mutations, DNA fragmentation and DNA structural breaks. Genetic mutations and cellular damage can potentially contribute to cancer growth.

Strong effects have been found in stem cells. Since stem cells are more active in children , researchers are concerned that children are at increased risk.

Scientific data on the biological effects of radiofrequency (RF) indicate the need to pursue a precautionary approach to protect the exposed population. It is clear that RF radiation can cause single and double strand DNA breaks at exposure levels that are currently considered safe under FCC guidelines. - **Dr. Martin Blank of Columbia University in his letter to the LAUSD**.

"Neuronal damage may not have immediately demonstrable consequences, even if repeated. It may, however, in the long run, result in reduced brain reserve capacity that might be unveiled by other later neuronal disease or even the wear and tear of ageing. We can not exclude that after some decades of (often), daily use, a whole generation of users, may suffer negative effects such as autoimmune and neurodegenerative diseases maybe already in their middle age". **Dr. Salford, Dr. Nittby, and Dr. Persson in Effects of Electromagnetic Fields From Wireless Communication upon the Blood-Brain Barrier in the Bioinitiative Report.**

Endocrine System: Research has shown impacts on pineal gland, adrenal gland and thyroid gland. These glands balance hormones that involve sleep. Research has shown that low levels of microwave exposure can reduce melatonin. Melatonin is not just critical to maintaining our sleep rhythm but it is also an extremely important antioxidant that helps to repair damaged DNA and reduces the growth of cancer cells. Additionally, research shows thyroid hormone levels can be impacted by wireless radiation. It has been established that even a small change in thyroid hormones can alter the brain.

Numerous experimental studies link radiation from wireless transmitting devices to biological effects. Current research is raising serious concerns about long term health impacts.

"Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco."
-The 2011 European Commission Resolution 1815

A Selection of Research for each Health Issue is at the end of this online document.
Please also see The Bioinitiative 2012 and PowerWatch.

"Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." **The United Nation's Rio Declaration on the Environment and Development, 1992.**

World Health Organization

PRESS RELEASE N° 208 31 May 2011
IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use.

Background: Over the last few years, there has been mounting concern about the possibility of adverse health effects resulting from exposure to radiofrequency electromagnetic fields, such as those emitted by wireless communication devices. The number of mobile phone subscriptions is estimated at 5 billion globally.

From May 24–31 2011, a Working Group of 31 scientists from 14 countries has been meeting at IARC in Lyon, France, to assess the potential carcinogenic hazards from exposure to radiofrequency electromagnetic fields. These assessments will be published as Volume 102 of the IARC Monographs.

"This classification justifies the implementation of the Precautionary Principle...confirms the existence of non-thermal effects that can cause health risk and indicates that current safety standards are insufficient to protect health of the users."
- Dr. Darius Leszynski, member of the Expert Panel of the WHO's EMF Working Group in Column 23.

"The IARC Monographs classification of Radiofrequency Electromagnetic Fields (RF-EMF) covers the entire radiofrequency segment of the electromagnetic spectrum (30 kHz-300 GHz) including ...WiFi stations,.." --Robert A Baan PhD, IARC , 2012

Since the IARC classification in 2011, research has continued to show links to biological effects at low levels, well below current exposure standards and government regulations. Many scientists have stated that as of 2014, criteria has been met for a higher carcinogenic risk classification and they are calling for precautions so citizens can minimize exposure.

"The proper designation now, if a working group were to meet, would be category 2 ... making it a probable human carcinogen ... as you increase radiofrequency fields in our environment you will, in fact, increase the hazard." -Dr. Anthony Miller of the Dalla Lana School of Public Health, and IARC Advisor, in his Testimony to the Toronto Council in November 2013.

What is the US doing? The only research underway is a rodent study by the US National Toxicology Program on chronic low level wireless frequencies.

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TRANSCEND

TO: Los Angeles Unified School District
FROM: Martha R Herbert, PhD, MD
RE: Wireless vs. Wired in Classrooms
DATE: February 8, 2013

I am a pediatric neurologist and neuroscientist on the faculty of Harvard Medical School and on staff at the Massachusetts General Hospital. I am Board Certified in Neurology with Special Competency in Child Neurology, and Subspecialty Certification in Neurodevelopmental Disorders.

I have an extensive history of research and clinical practice in neurodevelopmental disorders, particularly autism spectrum disorders. I have published papers in brain imaging research, in physiological abnormalities in autism spectrum disorders, and in environmental influences on neurodevelopmental disorders such as autism and on brain development and function.

I recently accepted an invitation to review literature pertinent to a potential link between Autism Spectrum Disorders and Electromagnetic Frequencies (EMF) and Radiofrequency Radiation(RFR). I set out to write a paper of modest length, but found much more literature than I had anticipated to review. I ended up producing a 60 page single spaced paper with over 550 citations. It is available at http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf.

In fact, there are thousands of papers that have accumulated over decades –and are now accumulating at an accelerating pace, as our ability to measure impacts become more sensitive –that document adverse health and neurological impacts of EMF/RFR. Children are more vulnerable than adults, and children with chronic illnesses and/or neurodevelopmental disabilities are even more vulnerable. Elderly or chronically ill adults are more vulnerable than healthy adults.

Current technologies were designed and promulgated without taking account of biological impacts other than thermal impacts. We now know that there are a large array of impacts that have nothing to do with the heating of tissue. The claim from wifi proponents that the only concern is thermal impacts is now definitively outdated scientifically.

EMF/RFR from wifi and cell towers can exert a disorganizing effect on the ability to learn and remember, and can also be destabilizing to immune and metabolic function. This will make it harder for some children to learn, particularly those who are already having problems in the first place.

Powerful industrial entities have a vested interest in leading the public to believe that EMF/RFR, which we cannot see, taste or touch, is harmless, but this is not true. Please do the right and precautionary thing for our children.

I urge you to step back from your intention to go wifi in the LAUSD, and instead opt for wired technologies, particularly for those subpopulations that are most sensitive. It will be easier for you to make a healthier decision now than to undo a misguided decision later.

Thank you.

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Institute for Health and the Environment
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28 February 2011Chairman and Trustees

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Dear Sirs/Madams:
This is concerning potential adverse health effects associated with exposure to radiofrequency (RF) radiation, specifically that from wireless routers. I am a public health physician who has been involved in issues related to electromagnetic fields (EMFs) for a number of years. I served as the Executive Secretary for the New York Powerline Project in the 1980s, a program of research which showed that children living in homes with elevated magnetic fields coming from powerlines suffered from an elevated risk of developing leukemia. I have edited two books on effects of EMFs, including RF radiation. I served as the co-editor of the Bioinitiative Report (www.bioinitiative.org), a comprehensive review of the literature on this subject. The public health chapter from this report was subsequently published in a peer reviewed journal, and that is attached. Also I testified before the President's Cancer Panel on this subject in 2009, and a publication coming from that testimony is also attached. Thus this is a subject which I know well, and one on which I take a public health approach that has as a fundamental principle the need to protect against risk of disease even when one does not have all the information that would be desirable.

There is clear and strong evidence that intensive use of cell phones increases the risk of brain cancer, tumors of the auditory nerve and cancer of the parotid gland, the salivary gland in the cheek by the ear. The evidence for this conclusion is detailed in the attached publications. WiFi uses similar radiofrequency radiation (1.8 to 5.0 GHz), although the intensity of exposure in the immediate environment is much lower than what one gets from holding a cell phone close to your head. The difference between a cell phone and a WiFi environment, however, is that while the cell phone is used only intermittently a WiFi environment is continuous. In addition WiFi transmitters are indoors, where people (and in this case, children) may be very close to them. There is evidence from Scandinavian studies of cell phone usage that children who use cell phones are about five times more likely to develop brain cancer than if use starts as an adult. Thus it is especially important to protect children.

To my knowledge there has not been any health investigation of individuals living or working in WiFi environments as compared to others who are not. However, because the radiation is the same as those for cell phones, there is every reason to assume that the health effects would be the same, varying only in relation to the total dose of radiation. Wired facilities do not generate any RF radiation. While there is not specific proof that WiFi increases risk of cancer, there is certainly no evidence that it is safe. I urge you to not put WiFi in any school. Children should not be put at increased risk of developing cancer.

Yours sincerely,

David O. Carpenter, M.D.
Director, Institute for Health and the Environment, University at Albany

Sources of Wireless Microwave Radiation in Schools

Many school systems are bringing wifi enabled systems into schools. Wireless iPads, tablets, computers, laptops, printers, and DECT cordless phones emit radiation. In addition, school systems are enacting *Bring Your Own Device* policies which result in cell phones and a host of other wireless devices in use in classrooms on a daily basis.

Wi-Fi is TWO-way communication.
A tablet or laptop (just like a cellphone) is a microwave *transmitter .*

The published radiation level of mobile devices is called Specific Absorption Rate (SAR). An iPad on WiFi/3G has an SAR of 0.76-1.19 W/kg, compared to the SAR of an iPhone on GSM/CDMA at 0.547-1.18 W/kg when held immediately against the ear.

Current radiation guidelines do not consider total cumulative radiation from all wireless devices in the room and the environment.

A student is exposed to radiation from FOUR sources:

1. The students device.
2. The devices of all the other users in the classroom particularly those nearby.
3. The routers and other fixed devices (printers, etc.) *inside* the classroom and school.
4. Transmitters *outside* the school building, such as a cell tower.

Current guidelines were not set for chronic exposure, nor for non-thermal effects.

USA Guidelines coverage - protective of immediate acute thermal risks	30 minutes
Canadian Guidelines coverage- protective of acute thermal risks only	6 Minutes
One School Year for a child	1,080 hours
Kindergarten to High school graduation	**14,040 hours**
Total cumulative cell phone call time at which point the risk of gliomas (brain cancer) more than doubled in epidemiological studies cited by the World Health Organizations International Agency for the Research on Cancer's Monograph on RF Fields.	1,640 hours

*"We will not get rid of the Internet or computers. We should not ignore, however, the enlarging body of science that points to real threats to public health and, especially, our children's safety and well-being. The best approach is precautionary. Reduce the risk by reducing the microwave emissions. It is our obligation as physicians and parents to protect our children. They are the future and our lega*cy."
Dr. Cindy Russell, VP Environmental Health, in her recently published "Shallow Minds: How the Internet and WiFi Can Affect Learning" in the Santa Clara Medical Association Bulletin.

The Fine Print Manufacturer Warnings

All manufacturers of wireless devices have warnings which describe the minimum distance at which device must be kept away from users in order to not exceed the present legal limits for exposure to wireless radiation. For example, the FCC regulates that the exposure limit for laptop computers and tablets is set when devices are tested 20 cm away from the body.

Common Use of Wireless Devices Could Exceed Current Exposure Guidelines

Blackberry Bold 9930: "Keep the BlackBerry device at least 0.59 in. (15 mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry device is turned on and connected to the wireless network."
iPads: "to be sure that human exposure to RF energy does not exceed the FCC, IC, and European Union guidelines, always follow these instructions and precautions: Orient the device in portrait mode with the Home button at the bottom of the display, or in landscape mode with the cellular antenna away from your body or other objects."
Samsung 3G Laptop: "Usage precautions during 3G connection : Keep safe distance from pregnant women's stomach or from lower stomach of teenagers. Body worn operation: Important safety information regarding radiofrequency radiation (RF) exposure.To ensure compliance with RF exposure guidelines the Notebook PC must be used with a minimum of 20.8 cm antenna separation from the body."
iPhone 4: " To be sure that human exposure does not exceed the FCC guidelines, always follow these instructions... keep iPhone at least 15 mm (5/8 inch) away from the body, and only use carrying cases, belt clips, or holders that do not have metal parts and that maintain at least 15 mm (5/8) inch separation between the iPhone and the body." To view the information on your iPhone go to Settings > General > About > Legal > RF Exposure.
Belkin WIFI Router Manual: "Caution: Exposure to Radiofrequency Radiation: The device shall be used in such a manner that the potential for human contact normal operation is minimized. This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body."
HP Printer: "In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20 cm (8 inches) during normal operation."

Why are these Fine Print Warnings important?

If these distances are not maintained, people can be exposed to radiation at levels that exceed the current FCC standard, potentially exposing them to thermal exposures. For example, laptops are tested at 20 cm (about 8 inches) AWAY from the body. The regulation requires that the SAR be less than 1.6 W/kg for any 1 gram of tissue, 20 cm (~8 inches) from the device. Because of the inverse square law at 10 cm, the SAR could double; at 5 inches it could increase 16-fold, and at 2 cm (*i.e. on your lap*) **it could increase 100-fold.**

Federal Regulations and Technology Use in Schools

"mobile devices are transmitters designed to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons." FCC, BULLETIN 65, 1997

Questions to Consider

Are students using WIFI laptops at 8 inches away from their body?
Are students using cell phones at the FCC recommended distances from their ears?
Are students aiming the tablet's antenna "away" from their bodies?
Do staff have offices set up whereby the WiFi printer is directly next to their body?
Are pregnant students and staff aware of the location of these sources of microwave radiation?

Most people, especially children and young adults, carry and use their wireless devices directly against their bodies. Consumers do not know that using a laptop on your lap, clutching an ipad to your chest or tucking a cell phone in your pocket or bra is potentially unsafe and could result in the user getting radiation exposures that exceed the standard. Since warnings are deep in the legal fine print of manuals and on manufacturer websites, they are often overlooked.

This was confirmed in the 2012 Government Accountability Office (GAO) study, which stated, **"Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit**." For example, cell phones are NOT tested touching the ear, but with a space (just less than an inch) between the ear and the phone.

What Can Schools Do?

Staff and students need to be informed of this information concerning federal regulations. This information can be incorporated into the Student Handbook and detailed in the Bring Your Own Device Policies that many schools are developing. Schools can teach students and staff ways to minimize exposures and develop policies that minimize radiation exposures from the devices students bring in.

Schools can raise awareness about this information to students, staff and their families so that people have the information they need to use technology in safer ways at home as well as at school.

Important Note: Federal guidelines were set only for thermal effects. Biological effects are not considered in these guidelines. Furthermore, compliance with current guidelines does not necessarily mean that children and pregnant women are even protected from thermal effects as their absorption rates were not considered during the development of standards. Research is raising serious safety issues concerning these current guidelines.

Inadequacy of Current Exposure Guidelines to Protect Children

Parents would never give their children pesticides or jet fuel to play. These agents are also classified along with cellphone and wireless radiation as possible human carcinogens by the WHO. Around the world we are paying the price now for having delayed actions on tobacco and asbestos after insisting on human harm before taking action. We cannot afford to wait for definitive proof of human risks from radiation emitted by wireless transmitting devices before taking steps to reduce exposures. The absence of evidence of hazard is not proof of safety.

1. Current US and Canadian Radio Frequency Exposure Standards are Inadequate to protect human health. Long term safety testing was never done. Doctors are raising grave concerns.

"The International Agency for Research on Cancer (IARC), part of the United Nations' World Health Organization, said in June 2011 that a family of frequencies that includes mobile-phone emissions is "possibly carcinogenic to humans." ...These studies and others clearly demonstrate the need for further research into this area and highlight the importance of reassessing current policy to determine if it is adequately protective of human health."
-Dr. Thomas K. McInerny, President of the American Academy of Pediatrics , in the AAP Submission to the FCC on August 29, 2013 calling for more protective guidelines in the USA.

"The Royal Society panel has failed in it's obligation to the public. It ignored recent evidence that wireless radiation is a probable carcinogen," **said Dr. Anthony Miller, Professor Emeritus of the Dalla Lana School of Public Health in his review of the Royal Society's 2014 Safety Code 6 Review.**

2. The testing procedures that define current standards do not consider smaller size of children and teen brains.

- The World Health Organization cites the study, "Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children," (Gandhi et al, 2011), which documents how the industry-designed process for evaluating microwave radiation from phones results in children absorbing twice the cell phone radiation to their heads, up to triple in their brain's hippocampus and hypothalamus, greater absorption in their eyes, and as much as 10 times more in their bone marrow when compared to adults.

3. Current exposure standards were set to protect against heating injury only. They do not protect against other mechanisms of action nor against chronic low level exposures such as daily exposure to wireless radiation.

"The FCC's current exposure guidelines, as well of those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non ionizing Radiation Protection (ICNRP), are thermally based, and do not apply to chronic, non-thermal exposure situations. They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn…" Norbert Hankin of the EPA 2002

DID YOU KNOW?

1. Microwave absorption tests use a liquid filled plastic head representing a 200 pound man.
2. The FDA and the EPA have not done a current Human Health Risk Assessment.
3. The FCC is in review of US RF guidelines and over 900 submissions are on the docket.

Concerns About Current Microwave Exposure Guidelines

Countries like Switzerland, Italy, France, Austria, Luxembourg, Bulgaria, Poland, Hungary, Israel, Russia and China have set exposure limits 100 to 10,000 times less than the USA and Canada

"The electromagnetic radiation standards used by the Federal Communications Commission continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today… Laboratory studies have raised concerns about impacts of low-level, non-thermal electromagnetic radiation...on domestic chicken embryos- with some lethal results"
- Willie Taylor, Director of the Office of Environmental Policy and Compliance of the US Department of the Interior, 2014.

"The FCC received 900 submissions regarding its cell phone radiation regulations. These documents reveal what we know about wireless radiation health effects, and why we need to strengthen regulations and provide precautionary warnings to the public." **Dr. Joel Moskowitz, School of Public Health, UC Berkeley CA**

"The FCC admits its own lack of expertise in the field. But the overlap of federal agency responsibilities for RF radiation protection and the merely advisory status of the Radiofrequency Interagency Work Group often leaves leadership unclear and encourages a pass-the-buck attitude…" - The Cities of Boston and Philadelphia's Submission to the FCC Docket 18-34, 11/18/1.

"Current standards do not account for children's higher RF exposures and greater health risks... The FCC should reject claims that there is no evidence pointing to potential harm from exposure to cell phone radiation. There are now numerous studies suggesting that RF exposure at current exposure levels could have negative health effects raising questions about the adequacy of current standards."
- The Environmental Working Groups 2013 Submission to the FCC.

In Canada, Safety Code 6 is "an archaic federal guideline that is allowing Canada's globally envied health care system to ignore our biggest modern health threat… There is nothing less than the future of our children at stake." **-Frank Clegg, Former Microsoft Canada President and founder of Canadians for Safe Technology.**

"...the FCC's cell phone emission levels and federal standards are based solely on radiation absorbed by adults. The FCC's 1.6 W Kg SAR standard is modeled on an adult head. This exposure standard leaves very little safety margin to account for the extra sensitivity of children. As a result, the FCC standards do nothing to ensure that a child using a cell phone does not absorb an amount of radiation above the maximum allowed limits." -**The City of San Francisco's 11/1/2013 Submission to the FCC.**

Health organizations called on the US FCC in 2013 to **re-evaluate** current exposure guidelines on radio frequency radiation including: The Breast Cancer Fund, Healthy Child Healthy World, Black Women for Wellness, Breast Cancer Action, The Center for Health Environment and Justice, Teens Turning Green, Science and Environmental Health Network, California Brain Tumor Association.

"Many bioeffects and adverse health effects occur at far lower levels of RF exposure than those that cause measurable heating; some effects are shown to occur at several hundred thousand times below the existing public safety limits, which are set based on the fallacious assumption that there are no adverse health effects at exposures that do not cause easily measurable heating." -**David O. Carpenter, MD, Director of the Institute for Health and the Environment at the University at Albany.**

Considerations for Schools

Schools need to provide safe learning environments and safe working conditions for staff.

Frameworks for Decision Making

ALARA = As Low As Reasonably Achievable

The ALARA principle is an integral part of basic radiation safety planning in medical and industrial activities involving radiation. It grows out of the assumption that radiation carries with it some risk. This means that every activity involving exposure to radiation should be planned so as to minimize unnecessary exposure.

As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied. - **The European Commission Resolution 1815**

Wireless Systems are not Energy Efficient:

"The problem is that we're all accessing cloud services – things like webmail, social networking and virtual applications – over wireless networks. It's the modern way but wireless is an energy monster, it's just inherently inefficient. ...Our calculations show that, in 2015, the wireless networks we use to access cloud services will command around 90% of the energy needed to power the entire wireless cloud services ecosystem….This is an increase in carbon footprint from 6 megatonnes of CO2 in 2012 to up to 30 megatonnes of CO2 in 2015, the equivalent of adding 4.9 million cars to the roads.

The CEET Report: The Power of Wireless Cloud .

The Precautionary Principle

If an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus, the burden of proof that it is *not* harmful falls on those taking an action.

The dearth of legislation to regulate the installation of BTS (antenna towers) in close proximity to children's facilities and schools clearly constitutes a human rights concern according to the language of the Convention on the Rights of the Child... We conclude that, because scientific knowledge is incomplete, a precautionary approach is better suited to State obligations under international human rights law. - Claudia Roda and Susan Perry.

Fiber Optic/Ethernet Wired System verses Wireless:

Speed: Wireless broadband network speeds are significantly slower than fiber optic networks. In addition, the greater the number of users accessing a wireless access point at a given time, the greater is the degradation of service experienced by those users.
Capacity: Wired connectivity can offer over 15 times higher bandwidth.
Security: Wireless systems are easily intercepted, tapped and hacked.
Reliability: Wired systems do not have transmission and interference issues like wireless.
Cost: Wireless infrastructure must be continually upgraded and modified.
Energy: Radiation absorbed into humans is wasted energy. Minimizing RF = saving energy.
Health: Wired systems do not emit radiation and do not pose any potential health risks.

Best Practices

"It is in the best interest of the District, its Board, and the children, teachers and staff the District protects to provide healthy and safe school environments. ...Failing to select wired over wireless technologies will needlessly expose hundreds of thousands of school children, as well as faculty and staff of LAUSD to massive new and unnecessary RFR (Radio Frequency Radiation) exposures that are already designated as a Possible Human Carcinogen. ...Instead, the Board should adopt programs to expand wired internet infrastructure and "EMF/RFR best practices" including the use of wired (CAT-6 or other), cable modem internet, or fiber optic connections instead that do not produce toxic exposures."

-Cindy Sage of the Bioinitiative Report **Recommendations to the LAUSD**

Version 3.0 of the USA Northeast Collaborative for High Performance Schools Version Criteria
Low-EMF Best Practices in the INDOOR ENVIRONMENTAL QUALITY Section (USA)

EQ 15.2.2 Wired local area network (LAN) to reduce RF EMF
· Install a wired local area network (LAN) for Internet access throughout the school. Provide wired network connections for desktop computers, laptops, notebooks, and tablets. All wireless transmitters shall be disabled on all Wi-Fi-enabled devices. Provide wired input devices for computer workstations.

EQ 15.2.3 Wired Phones to reduce RF EMF in classroom
· Install easily accessible hard-wired phones for teacher and student use and prohibit installation and use of standard DECT cordless phones and cordless phones operating at 2.4 GHz and 5.8 GHz unless they have been laboratory tested to demonstrate that the cordless phone base station and handsets (whether placed in the charging station or not) do not emit RF EMF emissions in standby mode.

· Prohibit the use of cell phones and other personal electronic devices in instructional areas / classrooms. Additionally, they shall be required to be powered off or be in airplane mode (sleep mode is not sufficient) except during fire-life-safety drills and incidents.

Mobile Learning and Health Risks: Implications for Pedagogical and Educational Practices
Mikko Ahonen, PhD, Department of Computer Sciences, University of Tampere, Finland

Best Practices Recommendations:

- Keep Distance: Device away from head and body.
- Minimize exposure time, no base stations (Including WIFI) close to classrooms.
- Avoid continuous mobile data transfer, prefer synchronized, off line services.
- Use Ethernet Connection Most of the Time.

Wi-Fi Networks–Best Practice Guidelines for Saving Energy and Minimizing RF Exposure
Katharina Gustavs May 2013

Recommended:
Design for lowest maximum power output with dynamic power control.
Shut off wireless access points automatically when not in use.
Place access points away from users, minimum 5-10 meters.
Monitor radiation levels and monitor peak levels.
Any wireless services should always be restricted to clearly marked areas.
Best Practice: Use Wired Ethernet Port/adapter.

INTERNATIONAL PRECAUTIONARY ACTIONS

No medical or scientific organization states low level microwaves are “safe”. Due to the accumulating research showing biological impacts from wireless radiation governments and health authorities around the world are taking action to minimize exposure.

> “The IARC 2B classification implies an assurance of safety that cannot be offered—a particular concern, given the prospect that most of the world’s population will have lifelong exposure to radiofrequency electromagnetic fields.” - Dr. Jonathan Samet, physician and epidemiologist,, Chair of the World Health Organization’s EMF Working Group who made the Class 2 B classification, in a 2014 Commentary.

France: New Legislation and the National Agency for Health, Food and Environmental Safety (ANSES).

- 2013 The French National Assembly passed an amendment **banning** WiFi from nursery Schools and strongly discouraging Wi-Fi in their schools until its proven **“safe for human consumption.**”
- 2011 French Cell Phone Statute: Merchants must display SAR Radiation levels for different phone models, all phones must be sold with a headset, cell phone ads aimed at children younger than 14 are banned and phones made for children under 6 are banned.
- 2013 ANSES Report recommends hands free phones, SAR labeling, and “limiting the population's exposure to radiofrequencies… especially for children and intensive users, and controlling the overall exposure that results from relay antennas.”
- The French National Library along with other libraries in Paris, and a number of universities have removed all Wi-Fi networks.
- Herouville-Saint-Clair has removed all Wi-Fi equipment installed in municipal facilities. Priority was given to schools. WiFi is replaced in almost all schools by fiber optic cable.

Belgium: Federal Public Health Regulations on March 2013 due to Health Concerns for Children.

- Phones designed for children under 7 years old are prohibited from sale.
- Total Advertising Ban on cell phones aimed at children younger than 14.
- Mandatory Radiation SAR levels must be available for consumers at point of sale.
- Warning label on phones: “Think about your health – use your mobile phone moderately, make your calls wearing an earpiece and choose a set with a lower SAR value.”
- Recommendations include use of hands-free methods to keep the phone away from the body such as text messaging and not making calls when the signal is weak, such as in an elevator or in a moving vehicle.
- Ghent Municipality: Wireless internet is banned from spaces that cater to children between 0 and three: preschools and daycares to reduce exposure to microwave radiation.

Australia: In 2013 the Australian Radiation Protection and Nuclear Safety Agency issued Fact Sheet 14: titled *How to Reduce exposure from mobile phones and other wireless devices.*

- Reduce the risk from WiFi devices by “keeping them at a distance, for example placing the wireless router away from where people spend time”, and “reducing the amount of time you use them”.
- “ARPANSA recommends that parents encourage their children to limit their exposure.”

Finland: The Radiation and Nuclear Safety Authority issued recommendations for children which include: favoring text messages, parents limiting duration and amount of calls,the use of hands free devices, avoiding calls in a low reception area and keeping the phone away from the body.

- "With children, we have reason to be especially careful, because there is not enough research on children's mobile phone use", according to STUK research director Sisko Salomaa.

Israel: The Israeli Ministry Of Education has issued guidelines limiting WiFi and cell phone use in schools.

- Preschool through 2nd grade have banned the use of wireless networks.
- A hard wired direct cable connection is required if the teacher has a computer in the class.
- The Israeli Supreme Court ordered the Israeli government to reply on ceasing Wifi installations
- In third and fourth grade class internet is restricted to 3 hours per week.
- The Education Ministry has instructed all schools to perform radiation tests.
- Israel's Minister of Health Rabi Litzman stated that he supports a ban on Wi-Fi in schools.

Switzerland: The Governing Council of Thurgau Canton 2008 "The Governing Council recommends for schools to forgo the use of wireless networks when the structural makeup of a given school building allows for a wired network."

Germany: The German Federal Ministry for Radiation Protection states,"supplementary precautionary measures such as wired cable alternatives are to be preferred to the WLAN system."

- Bavaria: The State Ministry of Education and Cultural Affairs: "For precautionary reasons the Federal Office for Radiation Protection recommends for schools that if a wireless network is used to place its components in suitable locations and to prefer the use of wired network solutions whenever possible." In 2007 Parliament recommendation to all schools to *not* install wireless LAN networks.
- Frankfurt: "In Frankfurt's schools there will be no wireless networks in the short or mid term. The Local Education Authority did not wish to conduct a "large scale human experiment," said Michael Damian, spokesperson of the Head of the School Department Jutta Ebeling.

Austria: "The official advice of the Public Health Department of the Salzburg Region is not to use WLAN and DECT in Schools or Kindergartens." -Gerd Oberfeld, MD.

- The Austrian Medical Society has issues cell phone safety guidelines stating that cell phones should be used for as short of a time as possible and that children under 16 should not use cell phones at all. The state that wireless LAN leads to high microwave exposure.

United Kingdom: The UK National Health Service has specific Recommendations for children and cell phones as "children are thought to be at higher risk of health implications".

- "Children should only use mobile phones for essential purposes and keep all calls short. "
- For the public they have "recommendations to help lower any potential long-term risks" which include keeping calls short, keep phone away from the body on standby mode, only use it when the reception is strong and use a phone with an external antenna.

India: 2012 The Ministry of Communications and Information Technology issued EMF guidelines with new Exposure Limits lowered to 1/10 of the ICNIRP level, SAR labeling on phones.

- Official guidelines for cell phone use include: Headsets, Speakerphones, limiting cell use, increasing distance from devices, and choosing landlines.
- 2013: Supreme Court of India upholds a decision of the High Court of the State of Rajasthan to remove all cell towers from the vicinity of schools, colleges, hospitals and playgrounds because of radiation "hazardous to life."
- The Ministry of Communications and Information Technology has a webpage entitled " A Journey for EMF" detailing guidelines and current issues with wireless devices and cell towers.

Italy: The Italian Supreme Court ruled a man's brain tumor was caused by his cell phone use in 2012. The National Institute for Workmen's Compensation must compensate a worker with head tumor due to cell use.

Russia: The Russian National Committee on Non-Ionizing Radiation Protection has repeatedly warned about electromagnetic radiation impacts on children and recommended WiFi not be used in schools.

- "Thus, for the first time in the human history, children using mobile telecommunications along with the adult population are included into the health risk group due to the RF EMF exposure."
- "In children, the amount of so-called stem cells is larger than in adults and the stem cells were shown to be the most sensitive to RF EMF exposure."
- "It is reasonable to set limits on mobile telecommunications use by children and adolescents, including ban on all types of advertisement of mobile telecommunications for children."
- Decision of Russian National Committee on Non-Ionizing Radiation Protection 2008, "CHILDREN AND MOBILE PHONES: THE HEALTH OF THE FOLLOWING GENERATIONS IS IN DANGER."

Canada: Health Canada offers "Practical Advice" on reducing exposure to wireless radiation.

- Recommendations: 1. Limit the length of cell phone calls, 2. Replace cell phone calls with text, use "hands-free" devices and 3. Encourage children under the age of 18 to limit their cell phone usage
- "Health Canada reminds cell phone users that they can take practical measures to reduce RF exposure. The department encourages parents to reduce their children's RF exposure from cell phones since children are typically more sensitive to a variety of environmental agents...There is a lack of scientific information regarding the potential health impacts of cell phones on children."

European Environment Agency: "All reasonable measures to be taken to reduce exposures to electromagnetic fields, especially radiofrequencies from mobile phones and particularly the exposures to children and young adults. Current exposure limits to be reconsidered."

Resolution 1815: In 2011 The Parliamentary Assembly of the Council of Europe issued *The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment.*

A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours."

The Resolution calls for member states to:

- Implement "information campaigns about the risk of biological effects on the environment and human health, especially targeting children and young people of reproductive age. "
- "Reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."

"For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises."

The European Environment Agency Report "Late Lessons from Early Warnings, Volume II" 2013 Report details the accumulating science on radio frequency radiation, the significant risks of waiting and critical need to take precautionary action to reduce exposures to avoid widespread harm.

United States: Legislation has been introduced at the state and national level. Some Communities have issued proclamations, resolutions and and started initiatives to inform the public of wireless health issues.

Proposed Legislation

- **2012** The Cell Phone Right to Know Act H.R. 6358 was introduced receiving strong **s**upport from many organizations including the American Academy of Pediatrics. (AAP Letter here.) This legislation called for labels on mobile devices at point of sale, a comprehensive national research program to study whether exposure to wireless devices causes adverse biological effects directed by NIEHS and the EPA and exposure level regulation.
- 2014 The Maine LD 1013 **"The Wireless Information Act"** passed the State Senate and House but then failed to pass the second vote. The Bill requires manufacturer's information on radio-frequency exposure be visible on the outside of the cell phone's product packaging.
- **2014 Hawaii Senate Bill SB 2571** was introduced calling for a warning label encouraging consumers to follow the enclosed product safety guidelines to reduce exposure to radiation that may be hazardous to their health.
- **The San Francisco Cell Phone Right to Know Ordinance** was signed in 2011 requiring cell phone retailers to distribute an educational sheet created by the San Francisco Department of Environment that explains radiofrequency emissions from cell phones and how consumers can minimize their exposure. The CTIA sued the city and settled with the City to block implementation of the Ordinance in exchange for a waiver of attorneys' fees. The City still maintains a Cell Phone Information page with significant information on how to reduce exposure.
- Past Proposed Legislation includes SB 932 California, HM 32, New Mexico, HB 1408 Pennsylvania, and SB 679 Oregon.

Passed Initiatives

- **2012, Jackson Hole, Wyoming made a Proclamation of Cell Phone Safety** which cites concern over long term health effects as well as the increased risk the radiation poses to children.
- **Pembroke Pines, Florida passed Resolution 3362 which** expressed the City's "Urgent Concerns" about Wireless Radiation and Health, encourages citizens to read their manuals and presents information on how to reduce exposure by using a headset or speakerphone.
- **2010 Burlingame California City Council** voted to include cell phone safety guidelines in their Healthy Living in Burlingame initiative which include the WHO classification and precautions a consumer can take if concerned.
- **2010, Portland Maine**, Mayor Mavodenes, Jr. declared October "Cell Phone Awareness Month"

Examples of Schools Implementing Best Practices

2014: UPPER Sturt Primary School, Australia opts for "No WIFI"
2014: The St. Augustine School in Italy turned off Wifi and goes back to Wires.
2013 Winlaw Elementary School, B.C. Canada turned off WiFi.
2013 Te Horo Primary School New Zealand Replaced WIFI with cable-based internet.
2013 Kootenay Lakes District School Board BC (One school without Wi-Fi)
2013 Blaise-Cendrars High School, Switzerland. Teachers vote to remove WiFi.
2012 Kivioja primary school in Ylivieska Finland bans phones and minimizes Wireless.
2011 City of Lakes Waldorf School, Minneapolis, Minnesota USA
2011 Aurora School in Ontario removed Wifi and replaced with hardwired.
2011 North Cariboo Christian School in Quesnel, B.C., removed Wi-fi .
2011 Pretty River Academy in Ontario no WiFi.
2011 Wayside Academy, Peterborough, Ontario no Wi Fi.
2010 Surrey, BC Roots and Wings Montessori removed Wi-Fi.
2010 Ontario St. Vincent Euphrasia elementary school: Parents voted to turn off Wi-Fi.
2009 HEROUVILLE-SAINT-CLAIR wi-fi networks removed.

Parent Teacher Organizations

2013 Canadian Teacher Federation's Brief (200,000 elementary and secondary school teachers)

- "CTF is concerned about the lack of definitive research regarding the adverse health effects of Wi-Fi.
- "We propose a prudent approach to the use of Wi-Fi, especially where children are present."
- "We recommend an education program regarding the relative safety of Wi-Fi exposure and that appropriate resources be developed to educate the public regarding ways to avoid potential exposure risks of Wi-Fi access points and devices."
- "Pedagogical needs could be met in schools with an approach that limits exposure to Wi-Fi."

2013 United Teachers of Los Angeles, representing 40,000 teachers and staff

- Resolution passed: "I move that UTLA will abide by current National NEA Policy for Environmentally Safe Schools which states that all employees and stakeholders should be informed when there are changes in their exposure to environmental hazards including electromagnetic radiation and that all stakeholders and the public should be notified of any actual and potential hazards."

2013 Elementary Teacher's Federation of Ontario - over 76,000 teachers

- Label the location Of Wi-Fi access points.
- Develop a hazard control program related to wireless microwave radiation through JHSC.

2012; The Ontario English Catholic Teachers Association (45,000 Ontario teachers)

- Recommends a wired infrastructure as WIFI "may present a potential Health and Safety risk or hazard in the workplace...The safety of this technology has not thoroughly been researched and therefore the precautionary principle and prudent avoidance of exposure should be practiced."

2010 : UK VOICE ;The Union for Education Professionals- 20,000 members

- "Voice has advocated that new Wi-Fi systems should not be installed in schools, that existing systems should be turned off when not required and that schools should consider whether they really need to use Wi-Fi, which was developed to facilitate Internet access on the move rather than to be used as a convenient alternative to cables in dedicated IT facilities."

2010 Greater Victoria Teachers' Association

- Wi-Fi free zones should be available.
- On/Off routers recommended and record any adverse Wi-Fi health effects.
- Minimal or non-use within elementary schools.

2013 BC Teachers Federation adopted Wireless Resolutions and Proposed Resolutions

- "The BCTF supports members who are suffering from Electromagnetic Hypersensitivity by ensuring their medical needs are accommodated in the workplace."
- Proposed Resolutions "the World Health Organization's classification of radiofrequency/electromagnetic fields emitted by wireless devices as a 2B possible cancer risk to humans; that the BCTF ensures all teachers have the right to work in a safe environment, including the right to work in a Wi-Fi/ wireless-free environment."
- Recommendation to the Ministry of Education that school boards "begin immediate installation of on/off switches for Wi-Fi routers in schools, thereby reducing microwave radiation exposure and reducing health risks to members, and/or provide safer Ethernet cables or fibre optics".

2013 **The BC Confederation of Parent Advisory Councils** (BCCPAC) **of 821 Advisory Councils representing over 500,000 parents in British Columbia passed two resolutions.**

- Resolution 17 "calls on each Board of Education to have one public school at each education level that is free of Wi-Fi, cordless phones and cell phones. This school will only be equipped with wired computers and wired telephones for personal, educational and administrative purposes."
- Resolution 18 calls on Boards of Education to "cease to install Wi-Fi and other wireless networks in schools where other networking technology is feasible.**"** passed with a clear majority.

2008 Lucerne Elementary Secondary Arrow Lakes District SD 10 New Denver BC, Canada

- Opts for "No WIFI

"The National Education Association believes that all educational facilities must have healthy indoor air quality, be smoke-free, be safe from environmental and chemical hazards, and be safe from hazardous electromagnetic fields." **Section C-19 of the NEA 2013-2014 Resolutions**

DOCTORS AND SCIENTISTS APPEAL FOR STRICTER WIRELESS TECHNOLOGY REGULATION

Vienna Resolution 1998
Salzburg Resolution 2000
Stewart Report, UK 2000
Declaration of Alcalá 2002
Catania Resolution 2002
Freiburger Appeal 2002
Bamberger Appeal 2004
Maintaler Appeal 2004
International Association of Fire Fighters Resolution on Cell Towers 2004
Coburger Appeal 2005
Oberammergauer Appeal 2005
Haibacher Appeal 2005
Pfarrkirchener Appeal 2005
Freienbacher Appeal 2005
Lichtenfelser Appeal 2005
Hofer Appeal 2005
Helsinki Appeal 2005
Parish Kirchner Appeal 2005
Saarlander Appeal 2005
Stockacher Appeal 2005
Vancouver School Resolution 2005
Benevento Resolution 2006
Allgäuer Appeal 2006
WiMax Appeal 2006
Schlüchterner appeal
Brussels Appeal 2007
Venice Resolution 2008
Porto Alegre Resolution 2009
European Parliament EMF Resolution 2009
Dutch Appeal 2009
Int'l Appeal of Würzburg 2010
Copenhagen Resolution 2010
Seletun Consensus Statement 2010
Russian National Committee on Non-Ionizing Radiation Protection 2011
Potenza Picena Resolution 2011
World Health Organization 2011
Austrian Medical Association 2012
Resolution on Electromagnetic Health 2012
British Doctor Initiative 2013
BabySafe Project: Joint Statement on Pregnancy and Wireless Radiation 2014
Canadian Doctors Declaration to Health Canada 2014
Scientific Declaration to Health Canada (International Doctors) 2014

U. S. President's Cancer Panel Voices Concern

The 2009 U.S. President's Cancer Panel pointed to cell phones and other wireless technologies as potential causes of cancer. In its recommendations, the panel stated:

"Also, incidence of brain cancer, particularly glioma, and other types of cancer has increased concomitantly with use of cell phones and other modes of wireless communication. Although not all of the data are conclusive, this area should receive attention from the U.S. Government."

The panel recommended that people reduce their usage by making fewer and shorter calls, using hands-free devices so that the phone is not against the head, and refraining from keeping a phone on a belt or in a pocket.

"Even if cell phones raise the risk of cancer slightly, so many people are exposed that it could be a large public health burden." – Dr. Ted Schettler, Director of the Science and Environmental Health Network.

The USA EPA on Wireless Radiation.

"*Wireless technology is still relatively new, and world-wide, researchers continue to study the effects of long-term exposure. To date, the scientific evidence linking long-term use of cell phones to cancer or other health effects is not conclusive.*

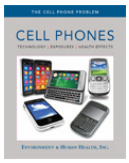
More research is needed to clarify the question of safety. "

- EPA Wireless Radiation Webpage as of 3/2014

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

The US CDC: Center for Disease Control

"Along with many organizations worldwide, we recommend caution in cell phone use. If RF does cause health problems, kids who use cell phones may have a higher chance of developing these problems in the future." The CDC website provides tips to the public on how to "reduce radio frequency radiation near your body."



THE CELL PHONE REPORT: TECHNOLOGY EXPOSURES, HEALTH EFFECTS, ENVIRONMENT & HUMAN HEALTH, INC.

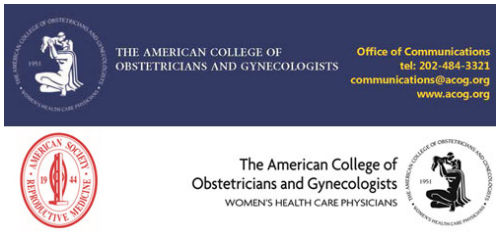
John Wargo, Ph.D., professor of Environmental Risk and Policy at Yale University and lead author of the report, said, "*The scientific evidence is sufficiently robust showing that cellular devices pose significant health risks to children and pregnant women. The weight of the evidence supports stronger precautionary regulation by the federal government. The cellular industry should take immediate steps to reduce emission of electromagnetic radiation (EMR) from phones and avoid marketing their products to children.*"

Recommendations to the Federal Government:

- Set exposure standards to protect human health.
- Evaluate cumulative exposure to radiofrequency radiation in pregnant women and children. Devices that contribute to total exposure include cell phones, cordless DECT (Digital Electronic Cordless Telecommunications) phones, wireless handsets, wireless headsets, wireless routers, Bluetooth devices, wireless alarm systems, etc.

Recommendations to Individuals

- Reduce your exposure to wireless radiation sources.
- Learn about EMF emissions from other wireless devices in your life, including computers, laptops, routers, DECT phones, etc.
- Try to minimize your cumulative exposure to these devices.



ACOG :Environmental Chemicals Harm Reproductive Health
Ob-Gyns Advocate for Policy Changes to Protect Health
September 23, 2013

Washington, DC -- Toxic chemicals in the environment harm our ability to reproduce, negatively affect pregnancies, and are associated with numerous other long-term health problems, according to The American College of Obstetricians and Gynecologists (The College) and the American Society for Reproductive Medicine (ASRM). In a joint Committee Opinion, The College and ASRM urge Ob-Gyns to advocate for government policy changes **to identify and reduce exposure to toxic environmental agents**.

"Lawmakers should require the US Environmental Protection Agency and industry to define and estimate the dangers that aggregate exposure to harmful chemicals pose to pregnant women, infants, and children and act to protect these vulnerable populations," said Jeanne A. Conry, MD, PhD, president of The College.

Associations Calling for Precautions

The Austrian Medical Association:
"Wi-Fi environments will lead to high microwave exposure for students and teachers which might increase the burden of oxidative stress. Oxidative stress might slow down the energy production especially in brain cells and may lead e.g. to concentration difficulties and memory problems in certain individuals. The Austrian Medical Association recommends Wi-Fi free school environments."- Gerd Oberfeld, MD, Public Health Department, Salzburg, Austria, on behalf of the Austrian Medical Association.

The American Academy of Environmental Medicine
"The peer reviewed, scientific literature demonstrates the correlation between RF exposure and neurological, cardiac, and pulmonary disease as well as reproductive and developmental disorders, immune dysfunction, cancer and other health conditions. It is better to exercise caution and substitute with a safe alternate such as a wired connection. While more research is being conducted, children must be protected. Wired technology is not only safer, it also stronger and more secure."

Switzerland Physicians for the Environment
"From the medical point of view, it is urgent to apply the precautionary principle for mobile telephony, wifi, etc." - Dr. Peter Kälin, President of Physicians for the Environment, 1,500 physicians in Switzerland.

Irish Doctors Environmental Association and The International Society of Doctors for the Environment
Both Organizations state that there is sufficient scientific evidence to warrant more stringent controls on electromagnetic radiation and they recommend:

- Avoid Wi-Fi in home or work if possible, particularly in schools or hospitals.
- Use wired technology whenever possible.
- Measure the radiation levels at sites which are occupied for prolonged periods, particularly by infants or young children.
- Base stations should not be located on or near [500m] schools or hospitals.

Russian National Committee on Non-Ionizing Radiation Protection

"Our Committee and I are personally against the use of Wi-Fi systems in schools. Professor Yury Grigoriev has the same opinion. The reason is that it forms a very complex form of electromagnetic field, but in this case the probability of biological effect is higher than when the same total dose is created by one source of unmodulated electromagnetic field. This pattern is for non-thermal electromagnetic fields. There are very good studies that have shown that prolonged exposure to low-intensity radio waves in children disturbed cognitive function, and we trust this research. " **-Professor Dr. Oleg Grigoriev, PhD, Director of the Russian Centre for Electromagnetic Safety and Vice-Chairman of the RCNIRP. Professor Yury Grigoriev, Dr. of Medical Science, Chairman of the Russian National Committee on Non-Ionizing Radiation Protection (RCNIRP).**

For more information please see the SAFE SCHOOLS 2012 Document.

Medical Doctors Raise Concern

"If we want to wait for final proof, at least in terms of cancer, it may still take 20 years and the issue will become that we will not have unexposed population to act as control. *We may never have the absolute final proof.* But we have enough data to go ahead with a precautionary principle." - **Dr Annie Sasco, Director, Epidemiology for Cancer Prevention, INSERM, Formerly International Agency for Research on Cancer, Unit Chief of Epidemiology for Cancer Prevention, Testimony to Canadian Parliament.**

"Wireless systems such as WiFi routers cannot be regarded as safe in schools, but must be deemed highly hazardous and unsafe for the children as well as for the staff."
- Olle Johansson PhD., Dept of Neuroscience, Karolinska Institute, Sweden

"Having done experiments on cellular model systems we have found an effect from electromagnetic radiation from WiFi. I have strongly suggested for years now that they should be used only if absolutely necessary in the home and not at all in schools. There is no reason for having WiFi in schools since there is an alternative - wired connections which are safer and faster".- **Professor Lukas H. Margaritis, PhD, Professor Emeritus of Cell Biology and Radiobiology, Dept of Cell Biology and Biophysics, University of Athens, Greece.**

"To my opinion, which is based on 25-year research of non-thermal effects of microwaves, usage of Wi-Fi and cell/mobile/smart phones in the classroom should be either forbidden or reduced as much as possible. I believe that the majority of scientists with long lasting experience in this scientific field are of the same opinion. " -**Dr Belyaev, Head Research Scientist, Cancer Research Institute, Slovak Academy of Science, Slovak Republic; Associate Professor in Toxicological Genetics, Faculty of Natural Science, Stockholm University, Sweden.**

"The concerns raised regarding the unnecessary and prolonged exposure of children to near-field radiofrequency electromagnetic radiation (RF-EMR) from mobile phones, wireless laptops (on their laps), and nearby Wi-Fi transmitters in schools are shared by many. A precautionary approach is realistically achieved without compromising convenience and safety." **-Dr Vini G. Khurana, Asst. Professor of Neurosurgery, Australian National University Medical School; Currently Visiting Attending Neurosurgeon, Royal Melbourne Hospital.**

"Wireless technologies have no place in schools. I strongly recommend that where they exist, they be replaced by fiber-optic cable and hard wiring."- **Samuel Milham MD, MPH, Epidemiology and Public Health, Former Washington State Health Dept., USA.**

Answers to Commonly Asked Questions
Children and Wireless Radiation

Q: Is wireless technology safe?
A: Wi-Fi and all radiofrequency radiation has been on the World Health Organization's Class 2B List of Possible Human Carcinogens for more than three years (since May 2011) based on research showing increased brain cancer in heavy users (30 minutes per day) with over 10 years of use. Lead and DDT are also included on this list. Recent research suggests that cancer is only the "tip of the iceberg" and low level wireless microwave radiation is now associated with a host of other concerning biological effects.

Q: What is known about safety for children?
A: Children are not little adults. Children's skulls are thinner and certain tissues of a child's head, including the bone marrow and the eye, absorb significantly more energy than those in an adult head. It is scientifically accepted that children are more vulnerable to the biological effects of microwave exposure than adults due their rapidly developing body systems. Stem cells are more active in children and stem cells are known to be more affected by microwave radiation.

There are no studies showing that microwave radiation exposure in children is safe and no studies showing that continuous exposure from cell phones, cell towers, cordless phones, Wi-Fi routers, baby monitors, etc. is safe.

Q: Is cell phone radiation the same as Wi-Fi radiation?
A: Commonly used cell phone and Wi-Fi signal frequencies are all classified as radiofrequency radiation. Dr. Robert Baan, a member of the International Agency for the Research on Cancer, has stated that the Class 2B Carcinogen status "holds for all types of radiation within the radiofrequency part of the electromagnetic spectrum, including the radiation emitted by base-station antennas, radio/TV towers, radar and Wi- Fi."

Q: Are children at increased risk ?
A: Due to their unique vulnerabilities children are thought to be at increased risk. Current research provides evidence. For example, Dr. Lennart Hardell and his research team at Orebro University in Sweden showed that children who start using a mobile phone in early years have an increased risk for developing a glioma by the time they are in their 20's. Experimental studies are showing significant neurological changes from exposure to microwave radiation levels that meet our FCC guidelines. Environmental exposures at critical periods can have profound effects on fetal and childhood development.

Q: Don't organizations such as the WHO, FDA, CDC, National Cancer Institute and the EPA say Wi-Fi is safe?
A: Representatives from these agencies do NOT declare that wireless is safe. They say there is inconclusive evidence and that "more research" is needed. The Center for Disease Control

recommends “caution”. Top scientists within the US National Cancer Institute (NCI), FDA and the Surgeon General insist upon undeniable proof of harm before taking any regulatory action.

Take, as an example, how the WHO classified outdoor air pollution as a Class 1 Carcinogen in September 2013 citing research indicating that in 2010 3.2 million deaths worldwide resulted from air pollution. When asked why it had taken so long to reach this conclusion, IARC director Dr. Christopher Wild said, “Often we're looking at two, three or four decades once an exposure is introduced before there is sufficient impact on the burden of cancer in the population to be able to study this type of question.” Similar to many other carcinogens, undeniable proof may not be available for decades.

The EPA states, “More research is needed to clarify the question of safety.” No medical organization that we know of has stated this radiation is safe.

Q: Hasn’t our government set safety standards based on a scientific review of the evidence?

A: The EPA and the FDA have never done a comprehensive scientific review of this radiation to set standards that protect human health. Current exposure standards were developed decades ago for radar military personnel at a time when wireless technology was not widespread as it is today.

Currently, the FCC is the agency that ensures compliance with radiofrequency exposure standards in this country. However, the FCC is not a medical nor science agency. Current standards have not been reviewed for over 18 years in the United States. Many experts in the field are calling the current standards outdated and inadequate to protect human health.

Q: I heard that the overwhelming majority of studies that have been published in scientific journals around the world show that wireless microwave radiation is *not* a health risk. Please explain this.

A: Actually the evidence for risk has increased. Since 2011, several new, major epidemiologic studies have been published that provide further evidence long-term mobile phone use is associated with increased risk of glioma (a type of malignant brain tumor) and acoustic neuroma (a nonmalignant tumor of the nerve that connects the ear to the brain). Moreover, the risks increase with the amount and duration of mobile phone use and are stronger on the side of the head where the mobile phone was predominantly used. If you set aside the industry-funded studies, the overwhelming weight of the evidence shows there is a significant problem. In addition to research on cancer, there are over 1000 peer reviewed, published papers showing harmful biological effects from microwave radiation exposure.

Q: What is the problem with current exposure standards?

A: There are several reasons that current FCC standards are considered inadequate:

- The guidelines were based on preventing thermal effects, i.e. heating. Yet thousands of peer-reviewed, published studies report non-thermal effects indicating biological changes from exposure to non-thermal radiation levels.
- The guidelines do not account for the cumulative effects of constant exposure to multiple sources all day and all night. FCC guidelines considered 30 minutes of exposure.
- The outdated guidelines do not consider research showing “hotspots” can develop in live brains.
- The guidelines were based on an adult male body’s absorption of radiation. Children’s smaller bodies and brains were not considered in the metrics.
- The guidelines consider average exposures, not peak exposures. Research suggests our biology is affected by the erratic nature of the signal and that our cells respond to these short intense bursts of radiation even if the average over time seems low.
- The guidelines do not consider the cumulative effects of radiation coming from multiple sources. Consider a child who has a cell tower at school, a bring your own device all day at school, Wi-Fi routers at home and school and who sits among 30 children’s devices in a class all day long. What is this child’s total exposure?

According to the EPA, “The FCC’s current exposure guidelines are thermally based and do not apply to chronic, non thermal exposure situations.” Wireless device use and Wi-Fi router radiation in the classroom is chronic, non-thermal radiation for the 1080 hours a child is in school each year.

Q: Are scientists and medical organizations concerned about how the inadequate standards might impact public health?
A: Yes. The American Academy of Pediatrics has called on the FCC to “Protect children’s health and wellbeing,” stating that “Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children.”

In 2014, researchers and scientists from around the world made a Declaration that Canadian Guidelines (which are similar to US guidelines) are inadequate to protect citizens. This comes after dozens of such declarations over the years. Please see our briefing book for details on each of these declarations.

In February of 2014, the US Department of the Interior accused the US Federal government of employing outdated wireless radiation standards stating, “the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today.”

Q: How are these exposure limits made?
The limits set for manufacturers use a plastic, liquid filled, computer model based on a 220-pound mannequin. Most of the population, including children, the fetus and women, are not

represented by this model. Significant research is making the point that such models do not adequately represent how the radiation penetrates young brains. In addition research suggests that living brains can develop hot spots from the radiation. The plastic mannequin model does not account for such vulnerabilities and cannot measure this hot spot issue because the liquid is of a uniform thickness unlike real brains comprised of different densities of tissues.

Q: How are wireless devices tested?
A: The FCC regulates that tablets and laptops are tested while placed at 20 cm away from the body. That is about 8 inches.

Q: Wouldn't companies be required to warn us about these radiation issues?
A: Every major manufacturer of wireless devices in the world issues warnings to keep their devices away from direct contact with the body. However, these fine print warnings are buried in the fine print of manuals and most parents and children are not aware the warnings exist.

Blackberry warns to keep their phones an inch away from any part of your body whenever turned on, "including the abdomen of pregnant women and the lower abdomen of teenagers."
Samsung 3G
"Usage precautions during 3G connection : Keep safe distance from pregnant women's stomach or from lower stomach of teenagers. Body worn operation: Important safety information regarding radiofrequency radiation (RF) exposure. To ensure compliance with RF exposure guidelines the Notebook PC must be used with a minimum of 20.8 cm antenna separation from the body."
iPad: "... to be sure that human exposure to RF energy does not exceed the FCC, IC, and European Union guidelines, always follow these instructions and precautions: Orient the device in portrait mode with the Home button at the bottom of the display, or in landscape mode with the cellular antenna (located under the black edge at the top of the device) away from your body or other objects..."

Q: So if my children use the wireless laptop at the manufacturer's recommended 20 cm distance on a table will they be safe?
A: The 20 cm measurement only pertains to thermal heating risks. It is questionable whether this exposure standard even adequately protects children from these thermal effects (as previously mentioned). Furthermore, there is no scientifically documented known safe level nor scientifically recommended distance to protect children from non-thermal effects.

Exposure is cumulative. Low doses add up, and it is unknown what the total cumulative exposures of children in a classroom with 30 operating devices are, much less a school with dozens of classrooms with routers and personal devices in use. There is no government agency, federal or municipal, that currently has the mandate, ability or resources to measure the cumulative effects of wireless radiation from multiple sources at home, work or school with Wi-Fi, cell phones, tablets, home cordless phones.

Even when a tablet is on a table, a child is absorbing radiation from the device. When it comes to safety considerations, using cords or cables for ethernet connectivity with Wi-Fi features turned off completely eliminates the risk from this microwave exposure.

Q: Is the Wi-Fi technology being used in schools the same as what is being used in most homes today?
A: No. Wi-Fi systems in school districts are usually much higher strength because they are designed to operate hundreds of computers simultaneously, unlike home based consumer systems that only operate a handful of computers.

Q: Should we be concerned about using Wi-Fi at home as well as at school?
A: A child working on a wireless device in a home will be absorbing the radiation from the device. We recommend using cords or cables for non-wireless connections whenever possible. Cell phones can be lifesaving tools and critical technology when we are traveling. However, our homes, like schools, are an example of a space where we can easily prefer non-wireless internet connections as we have specific locations where we use our computers.

Q: Wireless is everywhere. Are there really actions that will make a difference?
A: Children spend most of their time at home sleeping and at school learning. By making simple changes such as using cords and cables for computers and keeping devices on Airplane mode, a child's daily exposure will be significantly reduced. Since exposure is cumulative and children will have a lifetime to be exposed, such reduction actions will make a tremendous difference.

Q: What are the everyday sources of microwave radiation in our home?
A: Each electronic product that can wirelessly send voice, images, or data to another product or network emits microwave radiation. In addition to cell phones, here are some examples of devices that emit microwave radiation: tablets, laptops, digital baby monitors, cordless phones, printers, iPod Touch, wireless tv service, signal boosters, portable internet sticks, projectors, wireless gaming consoles, cordless keyboards, cordless speakers, "smart" watches, wifi or bluetooth fitness wristbands, and even your cordless computer mouse is a strong emitter. If a device can "sync" with your phone without a cord, then the device is wireless. Wireless radiation can be an emission from any size of communication device, computer, appliance, monitor, sensor, wearable, etc. Also, most microwave ovens, even when brand new, do leak microwave radiation out into rooms of the home when the oven is operating.

Q: I am not ready to give up my wifi, is there anything I can do?
A: You can significantly reduce your exposure by simply turning the wireless off (power off) when not in use, just as you would any appliance. Be sure to turn your router, cell phones, gaming consoles and all wireless devices off at bedtime. In addition, consider where the wifi router (and any other wifi source) is located and be sure that it is not near bedrooms or living spaces where any person (or pet) spends a large amount of time. Walls don't block wireless radiation.

You also can contact your internet provider, who can at no charge usually instantly remotely turn down the signal strength. Often the internet provider can explain how you can control that signal strength yourself online. Some routers are set to pump out radiation strong enough to reach 100 meters in all directions, but this is usually not necessary in our homes. If you talk to your neighbors about turning their signal strength down and more often off, this is a win-win as it will reduce your exposures to their wifi radiation emissions and of course also reduce their exposures.

Q: Wi-Fi router radiation levels are so low. How is this any different than the electromagnetic radiation that has been around since the Earth began?

A: Our society has never before been exposed to levels even remotely close to the current levels of microwave radiation in our workplaces, homes and schools today. Wi-Fi emits levels of radiofrequency microwave radiation millions of times higher than what our parents and grandparents ever experienced. Wireless routers in classrooms are like bringing mini cell towers into classrooms.

Q: Considering the number of people using wireless devices, shouldn't we be seeing an increase in brain tumor incidence, and we are not?

A: Cancer registries in the United States and several other countries are now showing some increased rates of brain cancer. Younger persons who have begun to use cell phones as teenagers are at the highest risk. The incidence of the worst brain cancer, glioblastoma, has increased in the United States and Denmark (Morgan et al, 2014). An Australian study has shown an overall significant increase in primary malignant brain tumors from 2000 to 2008, particularly since 2004. Another recent study (Zada et al, 2012) shows an increase in brain tumors in three major cancer registries in the United States. The increase seen is in the frontal and temporal lobes, which are the two regions closest to where a cell phone is typically held.

There is a long latency period for brain tumors – from 5 to as long as 50 years. Since cell phones have only been widely used in the US for two decades, the full increase in cancer rates is still unknown. Rates of autism, ADHD, diabetes, food allergies and immune diseases are skyrocketing, and it is understood that this increase cannot be due to genetics alone as the genome does not change in two decades. Environmental factors are increasingly thought to be behind this sharp rise. Like air pollution and chemical exposures, electromagnetic fields have been shown to increase stress on biological systems and impact the developing brain. Some research is pointing to a synergistic effect between toxic exposures such as lead and electromagnetic fields.

The 2011 IARC classification of cell phone radiation as a possible carcinogen was based on the evidence from human studies (European Interphone group and Hardell group in Sweden) and animal studies. Since that evaluation, in 2014, a new epidemiological study – the French CERENAT study was published. This new study reached similar conclusions as Interphone and Hardell – long term avid use of cell phone increases a risk of developing brain cancer. This

means we have three replications studies that all suggest cell phone radiation might increase a risk of brain cancer. These studies showing that over ten years use of cell phone at 30 minutes a day leads to an increased risk of brain cancer should be taken as a serious warning sign.

The Environmental Health Trust supports the use of technology in classrooms and applauds the creative use of digital resources. The use of technology and access to the internet does not require the constant exposure of children to microwave radiation. Cords and cables as wireline (non-wireless) connections are the safest option for internet access.

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2013, *A Radiofrequency Toolkit for Environmental Health Practitioners*. *BC CDC.* 1-371.

Aldad T, Gan G, Gao X, Taylor H.(2012). Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice. *Scientific Reports*. 2, 3-12.

Arnetz B, Akerstedt T, Hillet L, Lowden A, Kuster N, Wiholm C .(2007). The Effects of 884 MHz GSM Wireless Communication Signals on Self-reported Symptom and Sleep (EEG)- An Experimental Provocation Study *PIERS Online*. 3(7), 1148-1150.

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Gandhi OP, Morgan LL, De Salles AA, Han YY, Herberman RB, Davis DL. (2012). Exposure limits: the underestimation of absorbed cell phone radiation, especially in children. *Electromagn Biol Med*. 31(1), 3451.

Gultekin D, Moeller L. (2012). NMR imaging of cell phone radiation absorption in brain tissue. *National Academy of Sciences*. 110(1), 58–63.

Hankin N. (2002). Reply to Janet Newton's letter: Environmental Protection Agency. *Center for Science and Risk Assessment Radiation Protection Unit.*

Morgan L, Kesari S, Davis D. (2014). **Why children absorb more microwave radiation than adults: The consequences.** *Journal of Microscopy and Ultrastructure*. 2(2).

Peart K (2012). . "Cell phone use in pregnancy may cause behavioral disorders in offspring", *Yale News.*

Roda C, Perry S. (2014). Mobile phone infrastructure regulation in Europe: Scientific challenges and human rights protection.*Environmental Science & Policy*. 37, 204-214.

Russell C. (2013). Shallow Minds: How the Internet and Wi–Fi in Schools Can Affect Learning. Santa Clara County Medical Association.

Samet J, Straif K, Schuz J, Saracci R. (2014). Commentary: mobile phones and cancer: next steps after the 2011 IARC review. *Epidemiology*. 25(1), 23-7.

Taylor W. (2014). Letter to Mr. Eli Veenendaal of the National Telecommunications and Information Administration. *US Department of Commerce.*

Selected Examples of Research for Health Effects

Reproductive Effects

Adams J, Galloway T , Mondal D, Esteves S, Mathews F. (2014). **Effect of mobile telephones on sperm quality: A systematic review and meta-analysis.** *Environment International*. 80, 106-112.

- Our analyses indicate negative associations between mobile phone exposure on sperm viability and motility. The effects on concentration are more equivocal. Further research is required to quantify these effects more precisely and to evaluate the clinical importance of the risk to both sub-fertile men and the general population.

Agarwal A, Desai NR, Makker K, Varghese A, Mouradi R, Sabanegh E, Sharma R. (2009). **Effects of radiofrequency electromagnetic waves (RFEMW) from cellular phones on human ejaculated semen: an in vitro pilot study,** *Fertil Steril*. (4), 1318-25.

- "Radiofrequency electromagnetic waves emitted from cell phones may lead to oxidative stress in human semen. We speculate that keeping the cell phone in a trouser pocket in talk mode may negatively affect spermatozoa and impair male fertility."

Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G. (2013). **Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices.** *Journal of Pediatric Urology.* 9(2), 223-9.

- Significant increases in serum 8-hydroxy-2'-deoxyguanosine levels and 8-hydroxyguanosine staining in the testes of the experimental group indicating DNA damage due to exposure ($p < 0.05$).

Avendaño C, Mata A, Sanchez Sarmiento CA, Doncel GF.(2012). **Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation.** *Fertility Sterility.* 97(1), 39-45.

- Ex vivo exposure of human spermatozoa to a wireless internet-connected laptop decreased motility and induced DNA fragmentation by a nonthermal effect.

Azadi Oskouyi E, Rajaei F, Safari Variani A, Sarokhani MR, Javadi A. (2014). Effects of microwaves (950 MHZ mobile phone) on morphometric and apoptotic changes of rabbit epididymis. Andrologia.

- The epithelial height and diameter of the epididymis in 3 watt and 6 watt groups (2 weeks, 2 h a day with a frequency of 950 MHZ) had a significant decrease, the testosterone level only in 6 watt group was significantly decreased. The rate of apoptosis in the epithelial cells of the epididymis had a significant increase in 6 watt group.

- The **epididymis** is a tube connecting the ducts from each testicle to its vas deferens.

- "This study showed that the microwaves with the frequency of 950 MHz can have negative impacts on morphometric and apoptotic changes of rabbit epididymis.'

DeIuliis GN, Newey RJ, King BV, Aitken RJ.(2009). **Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro.** *Plos One July 31*, 4(7)

- In step with increasing SAR, motility and vitality were significantly reduced after RF-EMR exposure, while the mitochondrial generation of reactive oxygen species and DNA fragmentation were significantly elevated ($P<0.001$). Furthermore, we also observed highly significant relationships between SAR, the oxidative DNA damage bio-marker, 8-OH-dG, and DNA fragmentation after RF-EMR exposure.
- "These findings have clear implications for the safety of extensive mobile phone use by males of reproductive age, potentially affecting both their fertility and the health and wellbeing of their offspring".

Desai NR, Kesari KK, Agarwal A. (2009). **Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system.** *Reprod Biol Endocrinol.* 7, 114.

- "This review identifies the plasma membrane as a target of RF-EMW. In addition, the effects of RF-EMW on plasma membrane structures (i.e. NADH oxidase, phosphatidylserine, ornithine decarboxylase) and voltage-gated calcium channels are discussed.
- We explore the disturbance in reactive oxygen species (ROS) metabolism caused by RF-EMW and delineate NADH oxidase mediated ROS formation as playing a central role in oxidative stress (OS) due to cell phone radiation (with a focus on the male reproductive

system).
- This review also addresses: 1) the controversial effects of RF-EMW on mammalian cells and sperm DNA as well as its effect on apoptosis, 2) epidemiological, in vivo animal and in vitro studies on the effect of RF-EMW on male reproductive system, and 3) finally, exposure assessment and dosimetry by computational biomodeling".

Ghanbari M, Mortazavi SB, Khavanin A, Khazaei M. (2013). **The Effects of Cell Phone Waves (900 MHz-GSM Band) on Sperm Parameters and Total Antioxidant Capacity in Rats.** *International Journal of Fertility and Sterility* 7(1), 21-8.

- Sperm viability, motility, and total antioxidant capacity in all exposure groups decreased significantly compared to the control group ($p<0.05$).
- Increasing the duration of exposure from 2 to 3 weeks caused a statistically significant decrease in sperm viability and motility ($p<0.05$).
- "CONCLUSION: Exposure to cell phone waves can decrease sperm viability and motility in rats. These waves can also decrease sperm total antioxidant capacity in rats and result in oxidative stress."

Gul A, Celebi H, Uğraş S.(2009). **The effects of microwave emitted by cellular phones on ovarian follicles in rats.** *Arch Gynecol Obstet.* 280(5), 729-33.

- Exposure: 30 minutes every 24 hours pregnancy.
- **"** decreased number of follicles in pups exposed to mobile phone microwaves suggest that intrauterine exposure has toxic effects on ovaries."
- "microwaves of mobile phones might decrease the number of follicles in rats by several known and, no doubt, countless unknown mechanisms."

La Vignera S, Condorelli R, Vicari E, D'Agata R, Calogero A. (2012) **Effects of the exposure to mobile phones on male reproduction: a review of the literature.** *Journal of Andrology*. 33(3), 350-356.

- Review of Research: "The results showed that human spermatozoa exposed to RF-EMR have decreased motility, morphometric abnormalities, and increased oxidative stress, whereas men using mobile phones have decreased sperm concentration, decreased motility (particularly rapid progressive motility), normal morphology, and decreased viability. These abnormalities seem to be directly related to the duration of mobile phone use."

Markov M, Grigoriev YG.(2013). **Wi-Fi technology – an uncontrolled global experiment on the health of mankind.** *Electromagnetic Biology and Medicine. 32(2), 200-8*

- “For the first time in the history of mankind, because of aggressive use of mobile phones children are exposed to harmful non ionizing radiation and potentially are subject of larger risk than adults. Even if the dose received by the children’s brain is the same as for adults, due to the specificity of the body size and physiological development, children are in greater danger.”
- We should stop telling the science, politicians and general population that Wi-Fi is harmless... We should better be honest and say that “we do not know what long-term effects might be.”
- “the continuous non-controlled exposure of the entire civilization to low-intensity EMFs represents now more serious problem for the mankind than ionizing radiation where the sources of radiation are under strict control and are well localized”

Panagopoulos D, Johansson O, Carlo G. (2013). **Analysing the Health Impacts of Modern Telecommunications Microwaves.** PLoS One. 8(6).

- "In the present study we showed that microwave radiations used in modern mobile telecommunications can damage DNA and induce cell death or heritable mutations which may in turn result in reproduction decreases, degenerative diseases, or cancer. We analyzed the biophysical and biochemical mechanism underlying this biological impact, and discussed dosimetry and protection issues.
- All healthy organisms have defense mechanisms in order to repair biological damages. But defense mechanisms are weaker in children and old individuals, and become also weaker during sickness or during stress conditions. Although even the most serious biological effects may not necessarily lead to health effects in an exposed individual, all health effects are initiated by corresponding biological ones. Thereby, biological effects-especially the most serious ones as is DNA damage or cell death induction-may potentially lead to health effects.

Panagopoulos D. (2012). **Effect of microwave exposure on the ovarian development of Drosophila melanogaster.** *Cell Biochem Biophys*. 63(2), 121-32.

- “the ovarian size of the exposed insects is significantly smaller than that of the corresponding sham-exposed insects, due to destruction of egg chambers by the GSM radiation, after DNA damage and consequent cell death induction in the egg chamber” cells of the virgin females as shown in previous experiments on inseminated females.
- “The difference in ovarian size between sham-exposed and exposed virgin female flies becomes most evident 39-45 h after eclosion when the first eggs within the ovaries are at the late vitellogenic and post-vitellogenic stages (mid-late oogenesis). More than 45 h after eclosion, the difference in ovarian size decreases, as the first mature eggs of the sham-exposed insects are leaving the ovaries and are laid.”
- Marko Markov and Yuri G. Grigoriev of the National Committee of Non-Ionizing

Shahin S, Mishra V, Singh SP, Chaturvedi CM.(2014). **2.45 GHz Microwave Irradiation Adversely Affects Reproductive Function in Male Mouse, Mus musculus by Inducing Oxidative and Nitrosative Stress**. *Free Radic Res.* 48(5), 511-25.

- Significant decrease in sperm count , sperm viability , decrease in seminiferous tubule diameter, degeneration of seminiferous tubules. Reduction in testicular 3β HSD activity and plasma testosterone levels and increased expression of testicular i-NOS was observed.
- These "adverse reproductive effects suggest that chronic exposure to microwave radiation may lead to infertility via free radical species-mediated pathway."

Cancer:

(2011). **Non-ionizing radiation, Part II: Radiofrequency electromagnetic fields / IARC Working Group on the Evaluation of Carcinogenic Risks to Humans.** IARC Monogr Eval Carcinog Risks Hum. 102(2), 1-460.

- Radiofrequency electromagnetic fields are *possibly carcinogenic to humans (Group 2B)." (p. 421)*
- ""Overall, the Working Group reviewed all the available evidence with regard to the use of wireless phones, including both mobile and cordless phones, and the risk of glioma. Time trends were considered, as were several early case–control studies and one cohort study. The evidence from these studies was considered less informative than the results of the INTERPHONE study and the Swedish case–control study. While both of these are susceptible to bias, the Working Group concluded that these findings could not be dismissed as reflecting bias alone, and that a causal interpretation was possible."
- "In considering the evidence on acoustic neuroma, the Working Group considered the same methodological concerns as for glioma, but concluded that bias was not sufficient to explain the positive findings, particularly those of the study from Sweden." (p. 412)

Coureau G, Bouvier G, Lebailly P, Fabbro-Peray P, Gruber A, Leffondre K, Guillamo JS, Loiseau H, Mathoulin-Pélissier S, Salamon R, Baldi I. (2014). **Mobile phone use and brain tumours in the CERENAT case-control study.** *Occup Environ Med.* 71(7), 514-22.

- "CERENAT is a multicenter case-control study carried out in four areas in France in 2004–2006. No association with brain tumours was observed when comparing regular mobile phone users with non-users. However, the positive association was statistically

significant in the heaviest users when considering life-long cumulative duration for meningiomas and number of calls for gliomas Risks were higher for gliomas, temporal tumours, occupational and urban mobile phone use.

- These additional data support previous findings concerning a possible association between heavy mobile phone use and brain tumours."

Davis DL, Kesari S, Soskolne CL, Miller AB, Stein Y.(2013). **Swedish review strengthens grounds for concluding that radiation from cellular and cordless phones is a probable human carcinogen.** *Pathophysiology.* 20(2), 123-9.

- "Given that treatment for a single case of brain cancer can cost between $100,000 for radiation therapy alone and up to $1 million depending on drug costs, resources to address this illness are already in short supply and not universally available in either developing or developed countries. Significant additional shortages in oncology services are expected at the current growth of cancer. No other environmental carcinogen has produced evidence of an increased risk in just one decade...If the increased brain cancer risk found in young users in these recent studies does apply at the global level, the gap between supply and demand for oncology services will continue to widen. Many nations, phone manufacturers, and expert groups, advise prevention in light of these concerns by taking the simple precaution of "distance" to minimize exposures to the brain and body. We note than brain cancer is the proverbial "tip of the iceberg"; the rest of the body is also showing effects other than cancers."

Hardell L, Carlberg M, Söderqvist F, Mild K.(2013). **Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use.** *International Journal of Oncology* 43(6), 1833-45.

- For persons with more than 25 years latency period (time since first use until tumour diagnosis) a 3-fold increased risk was found. The risk increased further for tumours located in the most exposed area of the brain, the temporal lobe, to a 5-fold increased risk.
- "This study confirmed previous results of an association between mobile and cordless phone use and malignant brain tumours. These findings provide support for the hypothesis that RF-EMFs play a role both in the initiation and promotion stages of carcinogenesis".

Hardell L, Carlberg M, Hansson, Mild K. (2006). **Pooled analysis of two case-control studies on the use of cellular and cordless telephones and the risk of benign brain tumours**

diagnosed during 1997-2003. *International Journal of Oncology*. 509-18.

- In the multivariate analysis, a significantly increased risk of acoustic neuroma was found with the use of analogue phones.

Hardell L, Carlberg M, Söderqvist F, Mild KH.(2013). **Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones.** *Int J Oncol.* 43(4), 1036-44.

- "Ipsilateral use resulted in a higher risk than contralateral for both mobile and cordless phones. OR increased per 100 h cumulative use and per year of latency for mobile phones and cordless phones, though the increase was not statistically significant for cordless phones. The percentage tumour volume increased per year of latency and per 100 h of cumulative use, statistically significant for analogue phones. This study confirmed previous results demonstrating an association between mobile and cordless phone use and acoustic neuroma."

Hardell L, Carlberg M, Hansson Mild K. (2011)**. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects.** *Int J Oncol.* 38(5):1465-74.

- An increased risk was found for glioma and use of mobile or cordless phone. The risk increased with latency time and cumulative use in hours and was highest in subjects with first use before the age of 20.

Hardell L, Carlberg M. (2013). **Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones.** *Rev Environ Health.* 28(2-3), 97-106.

- "All nine issues on causation according to Hill were evaluated. The criteria on strength, consistency, specificity, temporality, and biologic gradient for evidence of increased risk for glioma and acoustic neuroma were fulfilled.
- Based on the Hill criteria, glioma and acoustic neuroma should be considered to be caused by RF-EMF emissions from wireless phones and regarded as carcinogenic to humans, classifying it as group 1 according to the IARC classification. Current guidelines for exposure need to be urgently revised."

Hardell L, Carlberg M, Hansson Mild K. (2013). **Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma.** *Pathophysiology.*

20(2):85-110.

- “We give an overview of current epidemiological evidence for an increased risk for brain tumours including a meta-analysis of the Hardell group and Interphone results for mobile phone use. ..It is concluded that one should be careful using incidence data to dismiss results in analytical epidemiology. The IARC carcinogenic classification does not seem to have had any significant impact on governments' perceptions of their responsibilities to protect public health from this widespread source of radiation”.

Myung S.K., Ju W, McDonnell D, Lee Y, Kazinets G, Cheng C, Moskowitz J.(2009). **Mobile Phone Use and Risk of Tumors: A Meta-Analysis.** *Journal of Clinical Oncology*, 27(33), 556.

- A Meta-Analysis- “The current study found that there is possible evidence linking mobile phone use to an increased risk of tumors from a meta-analysis of low-biased case-control studies. Prospective cohort studies providing a higher level of evidence are needed”.

Hearing loss

Dhiraj Maskey, Myeung Ju Kim. (2014). **Immunohistochemical Localization of Brain-derived Neurotrophic Factor and Glial Cell Line-derived Neurotrophic Factor in the Superior Olivary Complex of Mice after Radiofrequency Exposure.** *Neuroscience Letters.* 564, 78-82

- Significant decrements of BDNF immunoreactivity were noted in the lateral superior olive, medial superior olive, superior paraolivary nucleus and medial nucleus of the trapezoid body
- The decrease in the immunoreactivity of neurotrophic factors suggests a detrimental effect of RF exposure in the auditory nuclei.

Oktay M, Dasdag S. (2006). **Effects of intensive and moderate cellular phone use on hearing function.** *Electromagn Biol Med*. 25(1), 13-21.

- Brainstem evoked response audiometric (BERA) and pure tone audiometric (PTA) methods were used to measure the effects of exposure on hearing function of the subjects.
- Detection thresholds in those who talked approximately 2 h per day were found to be higher than those in either moderate users or control subjects.
- This study shows that a higher degree of hearing loss is associated with long-term exposure to electromagnetic (EM) field generated by cellular phones.

Panda N, Munjal S, Bakshi J. (2007). **Audiological Disturbances in Long-Term Mobile Phone Users.** *American Academy of Otolaryngology-Head and Neck Surgery Foundation.*

- 100 people who had used mobile phones for over a year suffered increases in the degree of hearing loss over the span of 12 months.
- The study discovered that people who used their phones for more than 60 minutes a day had a worse hearing threshold than those with less use.
- The authors warn users of cell phones to look out for ear symptoms such as ear warmth, ear fullness, and ringing in the ears (tinnitus) as early warning signs that you may have an auditory abnormality. They also suggest the use of earphones, which they found to be safer than holding a mobile phone up to the ears.

Sudan M, Kheifets L, Arah OA, Olsen J. (2013). **Cell phone exposures and hearing loss in children in the Danish National Birth Cohort.** *Paediatr Perinat Epidemiol.* 27(3), 247- 57**.**

- We observed weak associations between cell phone use and hearing loss at age 7, with odds ratios and 95% confidence intervals from the traditional logistic regression, MSM and DRE models being 1.21 [95% confidence interval [CI] 0.99, 1.46], 1.23 [95% CI 1.01, 1.49] and 1.22 [95% CI 1.00, 1.49], respectively.
- CONCLUSIONS:Our findings could have been affected by various biases and are not sufficient to conclude that cell phone exposures have an effect on hearing. This is the first large-scale epidemiologic study to investigate this potentially important association among children, and replication of these findings is needed.

Velayutham P, Govindasamy GK, Raman R, Prepageran N, Ng KH. (2014). **High-frequency hearing loss among mobile phone users.** *Indian J Otolaryngol Head Neck Surg*. 66(1), 169-72.

- Prospective single blinded study that used high-frequency audiometry.
- This study showed that there is significant loss in the dominant ear compared to the non-dominant ear ($P < 0.05$). Chronic usage mobile phone revealed high frequency hearing loss in the dominant ear (mobile phone used) compared to the non dominant ear.

Heart Function

Esmekaya MA, Ozer C, Seyhan N. (2011). **900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues.** *Gen Physiol Biophys***.** 30(1), 84-9.

- MDA and NOx levels were increased significantly in liver, lung, testis and heart tissues of the exposed group compared to sham and control groups .($p < 0.05$).
- Results of our study showed that pulse-modulated RF radiation causes oxidative injury in liver, lung, testis and heart tissues mediated by lipid peroxidation, increased level of

NOx and suppression of antioxidant defense mechanism.

Havas M, Marrongelle J. (2010). **Provocation study using heart rate variability shows microwave radiation from 2.4 GHz cordless phone affects autonomic nervous system.** *European Journal of Oncology.* 5, 273-300.

- 10 of the subjects (40 percent) displayed increased heart rate, arrhythmias (irregular heartbeats, a.k.a. heart palpitations).
- Four subjects experienced overt tachycardia, or intense and prolonged heart racing, after a second or two of exposure, with one subject's heart almost tripling its rate.
- Strong increases in sympathetic nervous activity and decreases in parasympathetic activity from exposures.

Havas M, Marrongelle J. (2013). **Replication of heart rate variability provocation study with 2.4-GHz cordless phone confirms original findings,** *Electromagnetic Biology and Medicine*. 32(2), 253-266.

- Double blind, sham-controlled study documented an increased Heart Rate, altered HRV and changes in the sympathetic and parasympathetic control of the Autonomic Nervous System.
- "Our results demonstrate that the radiation from a 2.4-GHz cordless phone affects the ANS and may put some individuals with preexisting heart conditions at risk when exposed to electromagnetic frequencies to which they are sensitive."

Headaches

Madhuri Sudan, Leeka Kheifets, Onyebuchi Arah, Jorn Olsen, Lonnie Zeltzer. (2012). **Prenatal and Postnatal Cell Phone Exposures and Headaches in Children.** *Open Pediatrics Medical Journal.* 46-52.

- Children with cell phone exposure had higher odds of migraines and headache-related symptoms than children with no exposure.

Szyjkowska A, Gadzicka E, Szymczak W, Bortkiewicz A. (2014). **The risk of subjective symptoms in mobile phone users in Poland - An epidemiological study.** I*nt J Occup Med Environ Health*. 27(2), 293-303.

- a questionnaire survey of 53 questions.
- Headaches were reported significantly more often by the people who talked frequently and long in comparison with other users

- Continuous headache, persisting for longer than 6 h since the end of a call, was reported by 26% of the subjects.
- Our results show that the mobile phone users may experience subjective symptoms, the intensity of which depends on the intensity of use of mobile phones.

Neurotoxic Effects/Neurological Impacts:

Bas O, Odaci E, Kaplan S, Acer N. (2009). **900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in adult rat.** *Brain Research.* 1265, 178–185.

- A statistically significant decrease in the pyramidal cells of the hippocampus and an increase in dark cells.

Bas O, Odaci E, Mollaoglu H, Ucok K, Kaplan S. (2009)**. Chronic prenatal exposure to the 900 megahertz electromagnetic field induces pyramidal cell loss in the hippocampus of newborn rats.** *Toxicol Ind Health*. 25, 377–384.

- Results: A significant reduction in the total number of pyramidal cells in the cornu ammonis of the hippocampus, which involves short-term memory and learning.
- Sixteen-week old rats are comparable to the age of human teenagers.

Bin Lv, Zhiye Chen, Tongning Wu, Qing Shao, Duo Yan, Lin Ma, Ke Lu, Yi Xie. (2014). **The alteration of spontaneous low frequency oscillations caused by acute electromagnetic fields exposure.** *Clin Neurophysiol.* 125(2), 277-86.

- 30 min LTE 4G exposure modulated the spontaneous low frequency fluctuations in brain regions.

Jing J, Yuhua Z, Xiao-qian Y, Rongping J, Dong-mei G, Xi C. (2012). **The influence of microwave radiation from cellular phone on fetal rat brain,** *Electromagn Biol Med.* 31(1), 57-66.

- Pregnant rats were exposed to different intensities of microwave radiation from cellular phones.
- Significant content differences were found in superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), malondialdehyde (MDA), noradrenaline (NE), dopamine (DA) after fetal brains were assayed.
- “Through this study, we concluded that receiving a certain period of microwave radiation from cellular phones during pregnancy has certain harm on fetal rat brains.”

Júnior LC, Guimarães ED, Musso CM, Stabler CT, Garcia RM, Mourão-Júnior CA, Andreazzi AE. (2014). **Behavior and memory evaluation of Wistar rats exposed to 1·8 GHz**

radiofrequency electromagnetic radiation. Neurol Res. 36(1).

- Frequency of rearing was increased by 193.3%, revealing an increase in exploratory activity of the animals, which is also related to anxiety, depression, and stressful behavior.
- Our data corroborate that reported by Narayanan et al., 21 who showed in 2012 that animals exposed to mobile phone radiation had an increased frequency of rearing.

Naziroğlu M. and Gumral. (2009). **Modulator effects of L-carnitine and selenium on wireless devices (2.45 GHz)-induced oxidative stress and electroencephalography records in brain of rat.** *Int J Radiat Biol.* 85(8), 680-689.

- Rats exposed to 2.45 GHz 60 min/day for 28 days had lower cortex brain vitamin A ($p < 0.05$), vitamin C ($p < 0.01$) and vitamin E ($p < 0.05$) concentrations.

Nittby H, Brun A, Eberhardt J, Malmgren L, Persson BR, Salford LG. (2010). **Effects of microwave radiation upon the mammalian blood-brain barrier.** *European Journal of Oncology.* 5, 333-355.

- EMF radiation leads to increased permeability of the Blood Brain Barrier (BBB) at non-thermal exposure levels.
- Damaging effects from radiofrequency EMF upon neurons has been shown after 28 days and 50 days.
- "The human BBB is very similar to the rodent BBB... it is our sincere belief, that it is more probable than unlikely, that non-thermal EMF from mobile phones and base stations do have effects upon the human brain.

Odaci E, Bas O, Kaplan S. (2008). **Effects of prenatal exposure to a 900 megahertz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study.** *Brain Research.* 1238, 224–229.

- Prenatal exposure caused a progressive postnatal decline in the number of granule cells of dentate gyrus of the hippocampus of offspring.

Qiao S, Peng R, Yan H, Gao Y, Wang C, et al. (2014) **Reduction of Phosphorylated Synapsin I (Ser-553) Leads to Spatial Memory Impairment by Attenuating GABA Release after Microwave Exposure in Wistar Rats.** *PLoS ONE.* 9(4)

- In the rat experiments, there was a decrease in spatial memory performance after microwave exposure. Both microwave exposure and p-Syn I silencing reduced GABA

release and maximal reduction was found for the combination of the two, indicating a synergetic effect.
- p-Syn I (ser-553) was found to play a key role in the impaired GABA release and cognitive dysfunction that was induced by microwave exposure.

Razavinasab M, Moazzami K, Shabani M. (2014). **Maternal mobile phone exposure alters intrinsic electrophysiological properties of CA1 pyramidal neurons in rat offspring.** Toxicol Ind Health. 30(2), 101-196.

- Mobile phone exposure was mostly associated with a decrease in the number of action potentials fired in spontaneous activity and in response to current injection in both male and female groups. There was an increase in the amplitude of the afterhyperpolarization (AHP) in mobile phone rats compared with the control.
- The results of the passive avoidance and Morris water maze assessment of learning and memory performance showed that phone exposure significantly altered learning acquisition and memory retention in male and female rats compared with the control rats.
- Our results suggest that exposure to mobile phones adversely affects the cognitive performance of both female and male offspring rats using behavioral and electrophysiological techniques.

Saikhedkar N, Bhatnagar M, Jain A, Sukhwal P, Sharma C, Jaiswal N. (2014). **Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain.** *Neurol Res.* 2(6), 2499-2504.
- Thus our findings indicate extensive neurodegeneration on exposure to radio waves. Increased production of reactive oxygen species due to exhaustion of enzymatic and non-enzymatic antioxidants and increased lipid peroxidation are indicating extensive neurodegeneration in selective areas of CA1, CA3, DG, and cerebral cortex. This extensive neuronal damage results in alterations in behavior related to memory and learning.

Sirav B, Seyhan N. (2011). **Effects of radiofrequency radiation exposure on blood-brain barrier permeability in male and female rats.** *Electromagnetic Biology and Medicine*. 30(4), 253-60.

- A significant increase in albumin was found in the brains of the RF-exposed male rats when compared to sham-exposed male brains.
- Radio frequency radiation “at levels below the international limits can affect the vascular permeability in the brain of male rats. The possible risk of RFR exposure in humans is a major concern for the society.”

Volkow ND, Tomasi D, Wang GJ, Vaska P, Fowler JS, Telang F, Alexoff D, Logan J, Wong C. (2011). **Effects of cell phone radiofrequency signal exposure on brain glucose metabolism.** *Journal of the American Medical Association*, 305(8), 808-13.

- A 50-minute cell phone exposure was associated with increased brain glucose metabolism in the region closest to the antenna.

Cognition/Memory

Aldad TS, Gan G, Gao XB, Taylor HS. (2012).**Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice.** *Scientific Reports;* 2, 312.

- the exposed group had dose responsive impaired neurologic transmission in the prefrontal cortex.
- the mice exposed in utero were hyperactive and had impaired memory.

Deshmukh PS, Banerjee BD, Abegaonkar MP, Megha K, Ahmed RS, Tripathi AK, Mediratta PK. (2013). **Effect of low level microwave radiation exposure on cognitive function and oxidative stress in rats.** *Indian J Biochem Biophys;* 50(2), 114-9.

- "Results showed significant impairment in cognitive function and increase in oxidative stress, as evidenced by the increase in levels of MDA (a marker of lipid peroxidation) and protein carbonyl (a marker of protein oxidation) and unaltered GSH content.
- "Low level MW radiation had significant effect on cognitive function and was also capable of leading to oxidative stress."

Megha, K Deshmukh, PS, Banerjee, BD, Tripathi, AK, Abegaonkar, MP. (2012). **Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats.** *Indian J Experimental Biology*. 50(12), 889-896.

- "Significant impairment in cognitive function and induction of oxidative stress in brain tissues of microwave exposed rats were observed."
- Increased oxidative stress due to microwave exposure may contribute to cognitive impairment and inflammation in brain."

Nittby H, Grafström G, Tian DP, Malmgren L, Brun A. (2008). **Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation.** *Bioelectromagnetics.* 29, 219–232.

- GSM exposed rats had impaired memory for objects and their temporal order of

presentation, compared to sham exposed controls (P=0.02).
- "Our results suggest significantly reduced memory functions in rats after GSM microwave exposure (P=0.02)."

Papageorgiou C, Hountala CD, Maganioti AE, Kyprianou MA, Rabavilas AD, Papadimitriou GN, Capsalis CN. (2011). **Effects of wi-fi signals on the p300 component of event-related potentials during an auditory hayling task.** *Journal of Integrative Neuroscience.* 10(2), 189-202.

- A WiFi access point was 1.5 meters away during blind exposures.
- In conclusion, the present findings suggest that Wi-Fi exposure may exert gender-related alterations on neural activity associated with the amount of attentional resources engaged during a linguistic test adjusted to induce Working Memory.

Behavior Issues:

Aldad TS, Gan G, Gao XB, Taylor HS. (2012). **Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice.** *Scientific Reports.* 2, 312.

- Mice that were exposed to radiation tended to be more hyperactive and had reduced memory capacity.
- Authors attributed the behavioral changes to an effect during pregnancy on the development of neurons in the prefrontal cortex region of the brain.

Divan HA, Kheifets L, Obel C, Olsen J. (2012). **Cell phone use and behavioural problems in young children.** *J Epidemiol Community Health.* 66(6), 524-9.

- The findings of the previous publication were replicated in this separate group of participants demonstrating that cell phone use was associated with behavioural problems at age 7 years in children, and this association was not limited to early users of the technology.

Divan HA, Kheifets L, Obel C, Olsen J. (2008). **Prenatal and postnatal exposure to cell phone use and behavioral problems in children.** *Epidemiology.* 19(4), 523-9.

- Exposure to cell phones prenatally-and, to a lesser degree, postnatally-was associated with behavioral difficulties such as emotional and hyperactivity problems around the age of school entry.

Sleep

Hillert L, Akerstedt T, Lowden A, Wiholm C, Kuster N, Ebert S, Boutry C, Moffat SD, Berg M, Arnetz BB. (2007). **The Effects of 884 MHz GSM Wireless Communication Signals on Self-reported Symptom and Sleep (EEG)- An Experimental Provocation Study.** *Bioelectromagnetics.* 3(7), 1148-1150.

- A prolonged latency to reach the first cycle of deep sleep (stage 3).
- The amount of stage 4 sleep was also decreased in exposed subjects.
- Subjects reported more headaches during exposures vs. sham exposure.

K. Mann and J. Röschke. (1996). **"Effects of Pulsed High-Frequency Electromagnetic Fields on Human Sleep,"** *Neuropsychobiology*. 33, 41-47.

- Shortening of sleep onset latency and a REM (Rapid Eye Movement) suppressive effect with reduction of duration and percentage of REM sleep.
- "The effects observed possibly could be associated with alterations of memory and learning functions."

Regel SJ1, Tinguely G, Schuderer J, Adam M, Kuster N, Landolt HP, Achermann P. (2007). **Pulsed radio-frequency electromagnetic fields: dose-dependent effects on sleep, the sleep EEG and cognitive performance.** *Journal of Sleep Research***.** 16(3), 253-8.

- Showed a dose-response relationship between EMF field intensity and its effects on brain physiology as demonstrated by changes in the sleep EEG and in cognitive performance.

Schmid MR, Murbach M, Lustenberger C, Maire M, Kuster N, Achermann P, Loughran SP. (2012). **Sleep EEG alterations: effects of different pulse-modulated radio frequency electromagnetic fields.** *Journal of Sleep Research.* 21(1), 50-8.

- "Consistent with previous findings, our results provide further evidence that pulse-modulated RF EMF alter brain physiology".
- Modulation frequency components within a physiological range may be sufficient to induce these effects.

Oxidative Stress

Augner C, Hacker GW, Oberfeld G, Florian M, Hitzl W, Hutter J, Pauser G. (2010). **Effects of exposure to GSM mobile phone base station signals on salivary cortisol, alpha-amylase, and immunoglobulin A.** *Biomed Environ Sci.* 23(3), 199-207.

- Increases of cortisol and a higher concentration of alpha-amylase were detected in subjects under various EMF exposure scenarios.

- RF-EMF in considerably lower field densities than ICNIRP-guidelines may influence certain psychobiological stress markers.

Cetin H, Nazıroğlu M, Celik O, Yüksel M, Pastacı N, Ozkaya MO. (2014)**. Liver antioxidant stores protect the brain from electromagnetic radiation (900 and 1800 MHz)-induced oxidative stress in rats during pregnancy and the development of offspring.** *J Matern Fetal Neonatal Med.* 27(6).

- "EMR-induced oxidative stress in the brain and liver was reduced during the development of offspring.EMR could be considered as a cause of oxidative brain and liver injury in growing rats".

Hamzany Y, Feinmesser R, Shpitzer T, Mizrachi A, Hilly O, Hod R, Bahar G, Otradnov I, Gavish M, Nagler RM.(2013). **Is Human Saliva an Indicator of the Adverse Health Effects of Using Mobile Phones?** *Antioxid Redox Signal.18(6), 622-7.*

- Significant increase in all salivary oxidative stress indices studied in mobile phone users.
- Salivary flow, total protein, albumin, and amylase activity were decreased in mobile phone users.
- "These observations lead to the hypothesis that the use of mobile phones may cause oxidative stress and modify salivary function."

Hou Q1, Wang M, Wu S, Ma X, An G, Liu H, Xie F. (2014)**. Oxidative changes and apoptosis induced by 1800-MHz electromagnetic radiation in NIH/3T3 cells.** *Electromagn Biol Med.*

- Our results showed a significant increase in intracellular ROS levels after EMR exposure
- The percentage of late-apoptotic cells in the EMR-exposed group was significantly higher than that in the sham-exposed groups ($p < 0.05$).
- These results indicate that an 1800-MHz EMR enhances ROS formation and promotes apoptosis in NIH/3T3 cells.

Nazıroğlu M, Yüksel M, Köse SA, Özkaya MO. (2013). **Recent reports of Wi-Fi and mobile phone-induced radiation on oxidative stress and reproductive signaling pathways in females and males**. *J Membr Biol.* 246(12), 869-75.

- Review Paper: "In conclusion, the results of current studies indicate that oxidative stress from exposure to Wi-Fi and mobile phone-induced EMR is a significant mechanism affecting female and male reproductive systems."

Tomruk A1, Guler G, Dincel AS. (2010). **The influence of 1800 MHz GSM-like signals on hepatic oxidative DNA and lipid damage in nonpregnant, pregnant, and newly born rabbits.** *Cell Biochem Biophys*. 56(1), 39-47.

- "the whole-body 1800 MHz GSM-like RF radiation exposure may lead to oxidative destruction as being indicators of subsequent reactions that occur to form oxygen toxicity in tissues"

Yakymenko. (2014). **Low intensity radiofrequency radiation: a new oxidant for living cells.** *Oxid Antioxid Med Sci.* 3(1), 1-3.

- A "strong non-thermal character of biological effects of RFR has been documented" and "it is clear that the substantial overproduction of ROS in living cells under low intensity RFR exposure could cause a broad spectrum of health disorders and diseases, including cancer in humans.
- Undoubtedly, this calls for the further intensive research in the area, as well as to a precautionary approach in routine usage of wireless devices."

DNA Impacts

Burlaka A, Tsybulin O, Sidorik E, Lukin S, Polishuk V, Tsehmistrenko S, Yakymenko.(2013). **Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation.** *Exp Oncol.* 35(3), 219-225.

- "Exposure of developing quail embryos to extremely low intensity RF-EMR of GSM 900 MHz during at least one hundred and fifty-eight hours leads to a significant overproduction of free radicals/reactive oxygen species and oxidative damage of DNA in embryo cells. These oxidative changes may lead to pathologies up to oncogenic transformation of cells."

Blank M, Goodman R.(2011). **DNA is a fractal antenna in electromagnetic fields**. *Int J Radiat Biol.* 87(4), 409-15.

- "The wide frequency range of interaction with EMF is the functional characteristic of a fractal antenna, and DNA appears to possess the two structural characteristics of fractal antennas, electronic conduction and self symmetry. These properties contribute to greater reactivity of DNA with EMF in the environment, and the DNA damage could account for increases in cancer epidemiology, as well as variations in the rate of chemical evolution in early geologic history."

Guler G, Tomruk A, Ozgur E, Seyhan N. (2010). **The effect of radiofrequency radiation on DNA and lipid damage in non-pregnant and pregnant rabbits and their newborns.** *Gen Physiol Biophys*. 29(1), 59-66.

- Malondialdehyde and 8-hydroxy-2-deoxyguanosine levels of non-pregnant and pregnant radiofrequency exposed animals significantly increased compared with not-exposed controls.
- The authors conclude, that 1800 MHz GSM-like radiofrequency exposure of non-pregnant and pregnant rabbits for seven days resulted in the release of secondary messengers, such as free radicals, leading to oxidative destruction in lipids and DNA.
- Rabbits prenatally exposed to cell phone radiation developed more indicators of DNA damage such as greater amounts of free radicals.

Güler G , Tomruk A , Ozgur E , Sahin D , Sepici A , Altan N, Seyhan N. (2012). **The effect of radiofrequency radiation on DNA and lipid damage in female and male infant rabbits.** *International Journal of Radiation Biology*. 88(4), 367–373.

- Lipid peroxidation levels in the liver tissues of female and male infant rabbits increased under RF radiation exposure. Liver 8-hydroxy-2 ' -deoxyguanosine (8-OHdG) levels of female rabbits exposed to RF radiation were also found to increase when compared with the levels of non-exposed infants.
- Conclusion: Consequently, it can be concluded that GSM-like RF radiation may induce biochemical changes by increasing free radical attacks to structural biomolecules in the rabbit as an experimental animal model.

Ruediger HW. (2009). **Genotoxic effects of radiofrequency electromagnetic fields.** *Pathophysiology. 16(2-3), 89-102.*

- Review:101 publications reviewed on the genotoxicity of radiofrequency electromagnetic fields (RF-EMF) in vivo and in vitro. Of these 49 report a genotoxic effect and 42 do not. In addition, 8 studies failed to detect an influence on the genetic material, but showed that RF-EMF enhanced the genotoxic action of other chemical or physical agents...Taking altogether there is ample evidence that RF-EMF can alter the genetic material of exposed cells in vivo and in vitro and in more than one way. This genotoxic action may be mediated by microthermal effects in cellular structures, formation of free radicals, or an interaction with DNA-repair mechanisms.

Tomruk A, Guler G, Dincel AS. (2010). **The influence of 1800 MHz GSM-like signals on hepatic oxidative DNA and lipid damage in nonpregnant, pregnant, and newly born rabbits.** *Cell Biochem Biophys*. 56(1), 39-47.

- This study looked at the biological effects of whole-body 1800 MHz GSM-like radiofrequency (RF) radiation exposure on liver oxidative DNA damage and lipid peroxidation levels in nonpregnant, pregnant New Zealand White rabbits, and in their newly borns.

- Key Findings: In nonpregnant RF exposed and pregnant RF exposed malondialdehyde (MDA) and ferrous oxidation in xylenol orange (FOX) levels were increased compared to non pregnant controls.
- In this study, we found that whole-body 1800 MHz GSM-like RF exposure for 15 min/day for a week could affect lipid peroxidation by increasing MDA and FOX levels in nonpregnants and pregnant.
- "the whole-body 1800 MHz GSM-like RF radiation exposure may lead to oxidative destruction as being indicators of subsequent reactions that occur to form oxygen toxicity in tissues"

Xu S, Zhou Z, Zhang L, Yu Z, Zhang W, Wang Y, Wang X, Li M, Chen Y, Chen C, He M, Zhang G, Zhong M. (2010). **Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons.** *Brain Research.* 22(1311), 189-96.

- **"**In this study, we exposed primary cultured cortical neurons to pulsed RF electromagnetic fields at a frequency of 1800 MHz modulated by 217 Hz at an average special absorption rate (SAR) of 2 W/kg. At 24 h after exposure, we found that RF radiation induced a significant increase in the levels of 8-hydroxyguanine (8-OHdG), a common biomarker of DNA oxidative damage, in the mitochondria of neurons. Concomitant with this finding, the copy number of mtDNA and the levels of mitochondrial RNA (mtRNA) transcripts showed an obvious reduction after RF exposure. Each of these mtDNA disturbances could be reversed by pretreatment with melatonin, which is known to be an efficient antioxidant in the brain.
- These results suggested that 1800 MHz RF radiation could cause oxidative damage to mtDNA in primary cultured neurons. Oxidative damage to mtDNA may account for the neurotoxicity of RF radiation in the brain."

Zhijian C, Xiaoxue L, Yezhen L, Shijie C, Lifen J, Jianlin L, Deqiang L, Jiliang H. (2009) **Impact of 1.8-GHz radiofrequency radiation (RFR) on DNA damage and repair induced by doxorubicin in human B-cell lymphoblastoid cells.** *Mutat Res*. 695(1-2), 16-21.

- "In vitro study, a comet assay was used to determine whether 1.8-GHz radiofrequency radiation (RFR, SAR of 2W/kg) can influence DNA repair in human B-cell lymphoblastoid cells exposed to doxorubicin (DOX)
- DNA damage was detected at 0h, 6h, 12h, 18h and 24h after exposure to DOX via the comet assay, and the percent of DNA in the tail (% tail DNA) served as the indicator of DNA damage.

- The results demonstrated that (1) RFR could not directly induce DNA damage of human B-cell lymphoblastoid cells; (2) DOX could significantly induce DNA damage of human B-cell lymphoblastoid cells with the dose-effect relationship, and there were special repair characteristics of DNA damage induced by DOX; (3) E-E-E type (exposure to RFR for 2h, then simultaneous exposure to RFR and DOX, and exposure to RFR for 6h, 12h, 18h and 24h after exposure to DOX) combinative exposure could obviously influence DNA repair at 6h and 12h after exposure to DOX for four DOX doses (0.075microg/ml, 0.10microg/ml, 0.15microg/ml and 0.20microg/ml) in human B-cell lymphoblastoid cells."

Endocrine System

Kesari KK, Kumar S, Behari J. (2011). **900-MHz microwave radiation promotes oxidation in rat brain.** *Electromagn Biol Med.* 30(4), 219-234**.**

- Significant decrease in the enzyme activities of glutathione peroxidase and superoxide dismutase, and an increase in catalase enzyme activity. Protein kinase C enzyme activity was significantly decreased in the samples of the exposed group (hippocampus and whole brain).
- A significant decrease in the level of pineal melatonin and a significant increase in creatine kinase and caspase 3 enzyme activities was observed in the exposed group (whole brain).
- A significant increase in the level of reactive oxygen species was also recorded.

Kesari KK, Kumar S, Behari J. (2012). **Pathophysiology of microwave radiation: effect on rat brain. Appl Biochem Biotechnol** . *Appl Biochem Biotechnol*. 166(2), 379-88.

- A significant decrease in the level of pineal melatonin of the exposed group.
- A significant increase in creatine kinase, caspase 3, and calcium ion concentration was observed in whole brain of exposed group of animals.
- The study concludes that a reduction in melatonin or an increase in caspase-3, creatine kinase, and calcium ion may cause significant damage in brain due to chronic exposure of these radiations. These biomarkers clearly indicate possible health implications of such exposures.

Koyu A, Cesur G, Ozguner F, Akdogan M, Mollaoglu H, Ozen S.(2005). **Effects of 900 MHz electromagnetic field on TSH and thyroid hormones in rats.** *Toxicology Letters.*157(3), 257-262.

- TSH values and T3-T4 at the 900 MHz EMF group were significantly lower.
- These results indicate that 900 MHz EMF emitted by cellular telephones decrease serum TSH and T3-T4 levels.

Kumar S, Kesari KK, Behari J.(2011). **The therapeutic effect of a pulsed electromagnetic field onthe reproductive patterns of male Wistar rats exposed to a 2.45-GHz microwave field.** *Clinics (Sao Paulo)*. 66(7), 1237-45.

- Significant increases in caspase and creatine kinase.
- Significant decreases in testosterone and melatonin in the exposed groups.
- This finding emphasizes that reactive oxygen species (a potential inducer of cancer) are the primary cause of DNA damage. However, pulsed electromagnetic field exposure relieves the effect of microwave exposure by inducing Faraday currents.

Mortavazi S, Habib A, Ganj-Karami A, Samimi-Doost R, Pour-Abedi A, Babaie A. (2009). **Alterations in TSH and Thyroid Hormones following Mobile Phone Use**. *Oman Med J. 24(4), 274–278.*

- A higher than normal TSH level, low mean T4 and normal T3 concentrations were found in mobile users.
- "It may be concluded that possible deleterious effects of mobile microwaves on hypothalamic-pituitary-thyroid axis affects the levels of these hormones."

Reviews of the Research:

Blank M, Goodman R.(2009). **Electromagnetic fields stress living cells.** *Pathophysiology. 16(2-3), 71-8.*

- "Electromagnetic fields (EMF), in both ELF (extremely low frequency) and radio frequency (RF) ranges, activate the cellular stress response, a protective mechanism that induces the expression of stress response genes, e.g., HSP70, and increased levels of stress proteins, e.g., hsp70.
- While low energy EMF interacts with DNA to induce the stress response, increasing EMF energy in the RF range can lead to breaks in DNA strands. It is clear that in order to protect living cells, EMF safety limits must be changed from the current thermal standard, based on energy, to one based on biological responses that occur long before the threshold for thermal changes".

Carpenter DO. (2013). **Human disease resulting from exposure to electromagnetic fields.** *Rev Environ Health.* 28(4), 159-72.

- This review summarizes the evidence stating that excessive exposure to magnetic fields from power lines and other sources of electric current increases the risk of development of some cancers and neurodegenerative diseases, and that excessive exposure to RF

radiation increases risk of cancer, male infertility, and neurobehavioral abnormalities.
- In summary, current extensive evidence shows that exposure to excessive levels of ELF and RF EMFs results in elevated rates of cancer and some other diseases, and such evidence is rapidly growing.

Cucurachi S, Tamis WL, Vijver MG, Peijnenburg WJ, Bolte JF, de Snoo GR. (2013). **A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF).** *Environ Int.* 51, 116-40.

- A systematic review of published scientific studies.
- In about two third of the reviewed studies ecological effects of RF-EMF was reported at high as well as at low dosages.
- "We propose in future studies to conduct more repetitions of observations and explicitly use the available standards for reporting RF-EMF relevant physical parameters in both laboratory and field studies."

Martin Pall. (2013). **Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects,** *Journal of Cellular and Molecular Medicine.17(8), 958-65.*

- This paper reviews 24 different studies in which EMF exposures produce biological effects that can be blocked by using calcium channel blockers, drugs that block the action of voltage-gated calcium channels (VGCCs).

- EMF exposures act by partially depolarizing the electrical charge across the plasma membrane of cells, activating the VGCCs and it is the increased intracellular calcium levels that are responsible for the reaction to EMF exposure.
- This review explains a mechanism for non-thermal biological effects from EMFs whereby voltage-gated calcium channels are opened up in the cell membrane, allowing calcium to leak into the cells.

Markovà E, Malmgren L, Belyaev I, (2010). **Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk,** *Environ Health Perspect.* 118(3), 394–399.

- "The strongest microwave effects were always observed in stem cells. This result may suggest both significant misbalance in DSB repair and severe stress response. Our findings that stem cells are most sensitive to microwave exposure and react to more frequencies than do differentiated cells may be important for cancer risk assessment and indicate that stem cells are the most relevant cellular model for validating safe mobile communication signals."

Morgan L, Kesari S, Davis D. (2014). **Why children absorb more microwave radiation than adults: The consequences.** *Journal of Microscopy and Ultrastructure*. 2(2).

- Computer simulation using MRI scans of children is the only possible way to determine the microwave radiation (microwave radiation) absorbed in specific tissues in children.
- Children absorb more microwave radiation than adults because their brain tissues are more absorbent, their skulls are thinner and their relative size is smaller.
- International Cancer registries are showing increased incidence of Cancer. Because the average latency time between first exposure and diagnosis of a tumor can be decades, tumors induced in children may not be diagnosed until well into adulthood.
- The fetus is particularly vulnerable to microwave radiation. Microwave radiation exposure can result in degeneration of the protective myelin sheath that surrounds brain neurons.
- The 20 cm rule for tablets/laptops violate the “normal operating position” regulation.
- Conclusions: Adolescent girls and women should not place cellphones in their bras or in hijabs. Selling toys that use wireless should be banned.
- Government warnings have been issued but most of the public are unaware of such warnings. Exposure limits are inadequate and should be revised such that they are adequate.

Yakymenko I, Sidorik E, Henshel D, Kyrylenko S. (2014). **Low intensity radiofrequency radiation: a new oxidant for living cells.** *Oxidants and Antioxidants in Medical Science.* 3(1), 1-3.

- The group reported that of 80 studies, they had assessed, 92,5 % (= 76 studies) confirmed that mechanism of inflicting damage. "Unexpectedly, a strong non-thermal character of biological effects" had been documented.
- Low intensity radiofrequency radiation (RFR) emitted by mobile phone end-user devices "could lead to mutagenic effects through expressive oxidative damage of DNA".
- "it is clear that the substantial overproduction of ROS in living cells under low intensity RFR exposure could cause a broad spectrum of health disorders and diseases, including cancer in humans. Undoubtedly, this calls for the further intensive research in the area, as well as to a precautionary approach in routine usage of wireless devices."