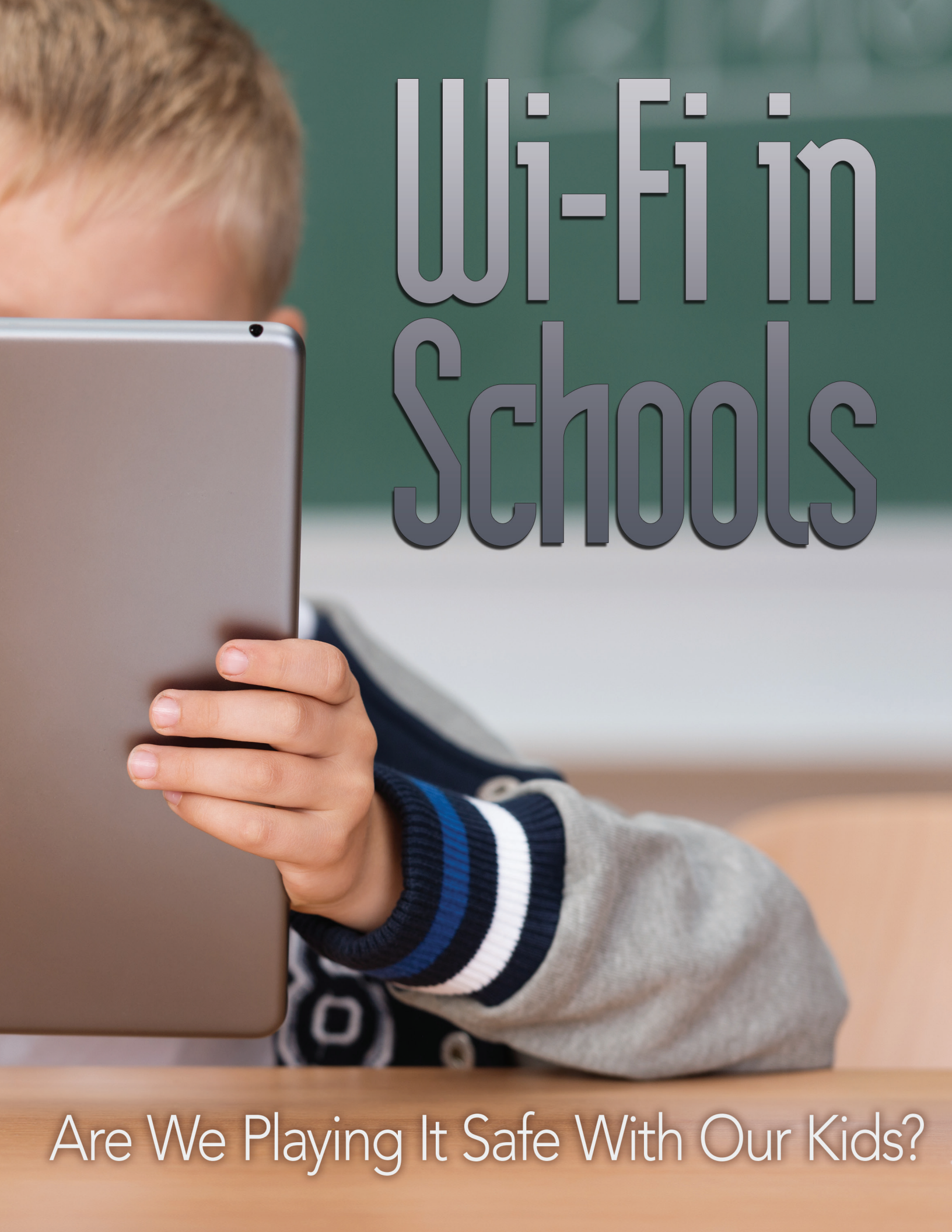


A young child with light brown hair is seen from the back, holding a silver tablet. The child is wearing a grey sweater with a blue and white striped cuff. They are sitting at a wooden desk. In the background, there is a green chalkboard and a white wall. The text 'Wi-Fi in Schools' is overlaid on the right side of the image in a large, stylized font.

Wi-Fi in Schools

Are We Playing It Safe With Our Kids?

“Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. 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.” American Academy of Pediatrics Letter to FCC August 29, 2013 (20)

By Cindy Russell, MD

VP of Community Health, SCCMA

Industry has been quite successful in creating magically useful wireless technologies such as cell phones, Ipads, Wi-Fi, and now wearable tech devices such as Google glasses, we all love. Many of these handy gadgets have now reached the typical classroom across the globe. It has become apparent, however, that there are substantial downsides to being too connected to technology and as safety concerns mount, governments such as France and Israel are backing away from the blind adoption of wireless technology in schools, especially for young children.

These devices are cool and convenient, however there remains nagging questions of overuse and safety as the application of these devices has increased to the point we are literally exposed 24 hours a day to this radiation. Wireless microwaves come from many sources both at work and at home.

An increasing number of physicians, scientists, and parents are concerned about long term health effects from Wi-Fi in schools. (42)(43)(44)(49) As any parent knows, computers now are as ubiquitous in schools as they are at work. From kindergarteners on up kids are required to learn computer skills in order to take core testing online. There is a push to enable students to be connected to the internet 24/7 to take photos, email documents, and research a topic. In schools, wired connections for computers have been rapidly being eliminated to install wireless systems that connect students both indoors and outdoors on campus.

Europe and some schools in the U.S. are taking a different more precautionary approach and going back to the future with wired plug in computers. Studies have also cast doubt on some of the benefits of classroom computers and warned of the new age of “Digital Dementia” which has now crept into Korean youth due to the heavy use of electronic gadgets. (17)(48)

Professors in college are banning computers during lectures and finding students learn more. (38) (39)

CHILDREN ARE MORE VULNERABLE THUS NEED MORE PROTECTION

Children have several organ systems that are immature at birth and are thus much more sensitive to toxic exposures. The human brain, one of the top vital organs, is far from being a finished product in youth. Long-term structural maturation of the nervous system is required for successful development of cognitive, motor, and sensory functions. Neuronal axons – long thin projections from the nerve cell – act as electronic transmission lines. Axons in major pathways of the brain continue to develop throughout childhood and adolescence. Myelin is the insulation surrounding individual nerves protecting it from outside electrical charges. The process of myelination is much faster the first two years but continues into adulthood. (16) Children have thinner skulls (29), their immune systems are undeveloped, their cells are dividing more rapidly, thus, they are more vulnerable to EMF radiation and other carcinogens. They also have a longer cumulative exposure to all toxins including EMF radiation.

CURRENT WIRELESS SAFETY STANDARDS AND MICROWAVING POTATOES

Wireless devices work on high frequency microwaves similar to the microwave you use to cook food with. It is with less power but substantial research (1)(2)(3)(4) demonstrates that even at low power within the current safety standards these microwaves can cause biologic harm to plants, animals, and cellular structures. Current Federal Communications Commission (FCC) standards are based only on heat generated by the device, not on adverse biological effects seen in hundreds of studies and at much lower levels.

Our own CMA supports reassessment of EMF standards. The California Medical Association, in 2014, passed a resolution as follows:

“Resolved 1: That CMA supports efforts to re-evaluate microwave safety exposure levels associated with wireless communication devices, including consideration

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of adverse nonthermal biologic and health effects from non-ionizing electromagnetic radiation used in wireless communications and be it further
Resolved 2: That CMA support efforts to implement new safety limits for wireless devices to levels that do not cause human or environmental harm based on scientific research.

ADVERSE EFFECTS DEMONSTRATED IN PEER REVIEWED PUBLISHED RESEARCH (2)

- DNA with single and double stranded breaks
- Leakage of the blood brain barrier (two hours of cell phone exposure causes 7+ days of albumin leakage)
- Stress protein production in the body indicating injury
- Infertility/reproductive harm
- Neurologic harm with direct damage to brain cells
- Lowering of melatonin levels
- Immune dysfunction
- Inflammation/oxidation.

PLAUSIBLE MECHANISM FOUND FOR EMF MICROWAVE EFFECTS

Dr. Martin Pall, Professor Emeritus of Biochemistry, Washington State University has studied how electromagnetic fields impact the cells of our bodies. His 2013 paper on this subject highlights a major biological mechanism of action of EMF microwave radiation on cell structure. His work, along with two dozen prior studies, demonstrated that EMF microwave radiation effects cellular calcium channels and this can be inhibited with calcium channel blockers. "A whole series of biological changes reportedly produced by microwave exposures can now be explained in terms of this new paradigm of EMF actions via Voltage Gated Calcium Channels (VGCC) activation." (14)(15)

EMF AFFECTS ON WILDLIFE: BIRDS, BEES, AND TOMATO PLANTS

Bird researchers in Germany found that their migratory European Robins lost their sense of navigation when in the city. (5) This was found to be due to the EMF radiation interfering with the bird's special internal magnetic compass. They replicated the experiment over seven years before publishing the results in the prestigious journal *Nature*.

John Phillips and others have found that newts, sea turtles, and migratory birds use a magnetic compass to navigate long distances and this can be interrupted by low levels of EMF. (6)(7) A review of effects on cell towers and wireless devices showed that beehives can have rapid colony collapse with exposure to cell phone radiation. (8)

Plants have been shown to have stress response to EMF from wireless devices. (9)(10) (22) In tomatoes exposed for short duration, the stress response seen by exposure to EMF was prevented by administration of calcium counteracting drugs. (11) Even simple high school science experiments document abnormal seed growth near Wi-Fi routers. (19) There appear to be adverse biological effects of this seemingly harmless radiation.

HUMAN ELECTROSENSITIVITY: IS IT REAL?

There is varied opinion about those who state they are sensitive to EMF. Scientific research has not given a definitive answer, nevertheless, many seem to suffer from vague and often disabling symptoms they feel in the presence of EMF. Exposure to EMF radiation in some people reportedly causes headaches, memory problems, fatigue, sleep disorders, depression. This is so significant for some people that they have to live in a very low EMF environment to feel normal. (25)

Sweden recognizes electro-sensitivity as a functional impairment and estimates that about 3% of the population suffers from this. (23)(24) Dr. Magda Havas found in replicated studies that some EMF sensitive individuals heart rates increased with wireless devices turned on in double blind study. (12)(26) Researchers at Louisiana State University, in 2011, studied a self reported EMF sensitive physician and found "In a double-blinded EMF provocation procedure specifically designed to minimize unintentional sensory cues, the subject developed temporal pain, headache, muscle twitching, and skipped heartbeats within 100 s after initiation of EMF exposure ($p < .05$)." They concluded that "EMF hypersensitivity can occur as a bona fide environmentally inducible neurological syndrome." (27)

Genius and Lipp reviewed the current literature on EHS, in 2011, and point to several explanations for this multisystem phenomenon, including toxicant induced loss of tolerance as many with EHS symptoms had high levels of PCB's possibly causing immune dysfunction. Scientific research also identifies an inflammatory response with cytokine production. Another aspect of research points to catecholamine and adrenal gland dysfunction. In addition, heavy metal toxicity has also been proposed as contributing to EHS. (28)

The Austrian Medical Association feels Electrohypersensitivity is a real phenomenon and in 2012 published Guidelines for EMF and Electro-hypersensitivity. They state the primary method of treatment should consist in the prevention or reduction of EMF exposure, taking care to reduce or eliminate all sources of EMF if possible. (32)

GOVERNMENT ACTIONS ON WI-FI IN SCHOOLS

While much of the U.S. is marching forward with Wi-Fi in schools, Europe is changing direction, as indicated by the policies listed below. (45) Internationally there is wide disagreement in standards. The U.S. and Canadian limits are 1000 microwatts/cm². China and Russia are 10 microwatts/cm². Belgium is 2.4 microwatts/cm², and Austria is 0.001 microwatts/cm². The Bioinitiative Report 2012 recommendation for "No Observable Effect" is 0.0003 microwatts/cm². Cosmic background EMF we evolved with is <0.0000000001 microwatts/cm². (2)

COUNCIL OF EUROPE PARLIAMENT ASSEMBLY 2011 EMF MICROWAVE POLICY : "THE POTENTIAL DANGERS OF ELECTROMAGNETIC FIELDS AND THEIR EFFECT ON THE ENVIRONMENT"

The report notes "other non-ionizing frequencies, whether from ex-

In May 2011, the International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B).(30)

tremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications, and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects, and animals, as well as the human body, even when exposed to levels that are below the official threshold values.”

The Council calls for a number of measures to protect humans and the environment, especially from high-frequency electromagnetic fields. One of the recommendations is to “take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumors”. (37)

IN FRANCE: A NEW NATIONAL LAW BANS WI-FI IN NURSERY SCHOOLS

In January 2015, France passed a landmark law that calls for precaution with wireless devices for children and the general public. (34)(35) It calls for:

1. Wi-Fi banned in nursery schools.
2. Wi-Fi routers should be turned off in school when not in use.
3. Schools are informed when new tech equipment is installed.
4. Citizens will have access to environmental cell tower radiation measurements near homes.
5. There will be continued research conducted into health effects of wireless communications.
6. Information on reducing exposure to EMF radiation is mandatory in the contents of the cell phone package.
7. Wi-Fi hotspots are labeled.

ISRAELI MINISTRY OF EDUCATION ISSUE GUIDELINES TO LIMIT WI-FI IN SCHOOLS

On August 27, 2013, the Israeli Ministry of Education issued new guidelines regarding Wi-Fi use in schools.

(33) The guidelines will:

1. Stop the installation of wireless networks in classrooms in kindergarten.
2. Limit the use of Wi-Fi between first and third grades. In the first grade, students will be limited to use Wi-Fi to study for one hour per day and no more than three days per week. Between the first and third grades, students will be limited to use Wi-Fi up to two hours per day for no more than four days per week.
3. To limit unnecessary exposure teachers will be required to turn off mobile phones and Wi-Fi routers when they are not in use for educational purposes.
4. All Wi-Fi equipment be tested for compliance with safety limits before and after installation in an Israeli school.
5. Desktop computers and power supplies be kept at least 20 cm from students.

2012 THE RUSSIAN COMMITTEE ON NON-IONIZING RADIATION PROTECTION



OFFICIALLY RECOMMENDED THAT WI-FI NOT BE USED IN SCHOOLS.

2011 THE RUSSIAN COMMITTEE ON NON-IONIZING RADIATION PROTECTION (RNCNIRP) RELEASED THEIR RESOLUTION ENTITLED “ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECTS ON CHILDREN AND TEENAGERS.”

According to the opinion of the Russian National Committee on Non-Ionizing Radiation Protection, the following health hazards are likely to be faced by the children mobile phone users in the nearest future: disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to the stress, increased epileptic readiness. (36)

Expected (possible) remote health risks: brain tumors, tumors of acoustical and vestibular nerves (in the age of 25-30 years), Alzheimer’s

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disease, “got dementia”, depressive syndrome, and the other types of degeneration of the nervous structures of the brain (in the age of 50 to 60).

PLAYING IT SAFE FOR OUR KIDS

A healthy and safe learning environment is a cornerstone of education. Current FCC standards are obsolete and inappropriate as they are based only on heat effects, not biological effects. They give us a false sense of security. There may be higher EMF levels at school than at home as routers are more powerful. Cumulative Effects on DNA or cell structures are not taken into consideration in any safety standard. Because of the long-term exposure to EMF microwave radiation this generation is experiencing, they will be at higher risk for potential health problems. We will not know what happens to our progeny’s DNA until our grandchildren are born.

Considering there has been a more precautionary approach internationally to microwave radiation exposure and the trend is toward less exposure in schools, especially to vulnerable populations such as children, it makes sense to re-evaluate our wireless schools. We buckle our seat belts and wear a helmet when we ride bikes even though we don’t know if we will get in an accident. Although not all the issues of wireless microwaves are understood, there is enough science to understand it acts as a toxicant at even low levels that fall within current safety standards. We also know

3. **Limit Wi-Fi use**, especially in younger grades.
4. **Cell phones stay off and in the backpacks during class** and on the campus during school hours.
5. **Have EMF and electrical measurements done by one or more qualified, experienced consultants before and after any installation.** Understand you may need to increase your knowledge of low and high frequency electromagnetic fields and limits to accurately interpret the reports. The Bioinitiative Report is a very useful compendium that has recommendations for safer levels.
6. **Support efforts by governments to provide independent standardized transparent research to define safe limits in all the different wireless frequencies used commercially.** This could lead to less EMF emissions and safer wireless devices.

REFERENCES

1. “Overpowered” by Dr. Martin Blank, 2014
2. **Bioinitiative Report.** 2012 <http://www.bioinitiative.org/>
3. **EMF Portal.** <http://www.emf-portal.de/>
4. **Why Fi? : Is Wireless Communication Hazardous to Your Health?** <http://www.sccma-mcma.org/Portals/19/assets/docs/Why%20Fi.pdf>
5. **Electronics’ noise disorients migratory birds.** Man-made

“Certain high frequency waves used in the fields of radar, telecommunications, and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects, and animals, as well as the human body, even when exposed to levels that are below the official threshold values.”

that decades of research precedes meaningful regulation in the area of toxins, thus the only reasonable approach is precautionary.

In addition, we need to be thoughtful about how much our kids should use computers and what this is doing not only to them, but to our society as a whole. We get starry eyed with every new wireless gadget, however, in “Alone Together” Sherry Turkle expertly addresses the rise in isolation, loneliness, lack of privacy, and increasing pressure on students in this age of invasive technology. Her thorough and non-judgmental scientific investigation of the psychological effects of computers makes us aware that we need to take care that we do not replace real human connection with a “virtual reality” that will redirect us in an unhealthy direction.

As physicians and parents, we understand that decisions we make today may have far reaching consequences in the future for our kids. Let’s play it safe for them right now.

RECOMMENDATIONS FOR SCHOOLS

1. **Wired internet connections** like we used to have are the safest and possibly cheapest option – all the benefits of the internet without the risk.
2. **Wireless devices**, but with an on/off switch in each room so teachers can use only when needed for educational purposes.

electromagnetic radiation disrupts robins’ internal magnetic compasses. May 7, 2014 <http://www.nature.com/news/electronics-noise-disorients-migratory-birds-1.15176>

6. **True Navigation: Sensory Bases of Gradient Maps.** Phillips, J. 2006 <http://www.pigeon.psy.tufts.edu/asc/Phillips/>
7. **A behavioral perspective on the biophysics of the light-dependent magnetic compass: a link between directional and spatial perception?** Phillips, J. Journal of Experimental Biology. June 17, 2010. <http://jeb.biologists.org/content/213/19/3247.full.pdf>
8. **Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – a review.** Sivani, S. *Biology and Medicine*. Dec 3, 2012 http://www.emrpolicy.org/regulation/united_states/Exhibit_19_EMRI_Sivani_Bio_&_Med_2012.pdf
9. **Effects of Microwaves on the Trees and Other Plants.** Balmori, A. 2003. http://www.hese-project.org/de/emf/WissenschaftForschung/Balmori_Dr._Alfonso/showDoc.php?lang=de&header=Dr.%20Balmori&file=THE%20EFFECTS%20OF%20MICROWAVES%20ON%20THE%20TREES%20AND%20OTHER%20PLANTS.html&back=../showAuthor.php?target=Balmori_Dr._Alfonso
10. **Effects of Electromagnetic Waves Emitted by Mobile Phones on**

- Germination, Root Growth, and Root Tip Cell Mitotic Division.** Pol J of Envir Studies. Nov 2010. <http://www.pjoes.com/pdf/21.1/Pol.J.Envir.Stud.Vol.21.No.1.23-29.pdf>
11. **Intercellular Communication in Plants: Evidence for an EMF-Generated Signal that Evokes Local and Systemic Transcriptional Responses in Tomato.** 2013. http://link.springer.com/chapter/10.1007/978-3-642-36470-9_16
 12. **Provocation Study using heart rate variability shows microwaves radiation from 2.4 Ghz cordless phones.** *European Journal of Oncology*. January 16, 2011. <http://www.bemri.org/publications/dect/341-provocation-study-using-heart-rate-variability-shows-microwave-radiation-from-2-4ghz-cordless-phone.html?path=>
 13. **Is newborn melatonin production influenced by magnetic fields produced by incubators?** *Early Hum Dev* 2012; 88 (8): 707 – 710 <http://www.emf-portal.de/viewer.php?aid=20376&l=e>
 14. **Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects.** Pall, ML. *J Cell Mol Med*. 2013 Aug;17(8):958-65. <http://www.ncbi.nlm.nih.gov/pubmed/23802593>
 15. **Microwave Electromagnetic Fields Act by Activating Voltage-Gated Calcium Channels: Why the Current International Safety Standards Do Not Predict Biological Hazard.** Professor Dr. Martin L. Pall <http://apps.fcc.gov/ecfs/document/view?id=7521102473>
 16. **Communication Studies UCLA.** <http://cogweb.ucla.edu/CogSci/Myelinate.html>
 17. **“Digital Dementia” on the Rise.** June 24, 2013 <http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=2973527>
 18. **International Precautionary Actions EMF.** <http://ehtrust.org/international-policy-actions-on-wireless/>
 19. **Student Science Experiment Finds Plants won’t Grow near Wi-Fi Router** <http://www.globalresearch.ca/student-science-experiment-finds-plants-wont-grow-near-wi-fi-router/5336877>
 20. **American Academy of Pediatrics Letter to FCC and FDA regarding EMF Exposure Policies and Standards.** <http://www.wirelesswatchblog.org/wp-content/uploads/2011/06/FCC-13-84-09-03-2013-American-Academy-of-Pediatrics-7520941318-1.pdf>
 21. **Transient DNA damage induced by high-frequency electromagnetic fields (GSM 1.8 GHz) in the human trophoblast HTR-8/SVneo cell line evaluated with the alkaline comet assay.** *Mutat Res*. 2010 Jan 5. <http://www.ncbi.nlm.nih.gov/pubmed/19822160>
 22. **High frequency (900 MHz) low amplitude (5 V m-1) electromagnetic field: a genuine environmental stimulus that affects transcription, translation, calcium and energy charge in tomato.** Roux, D. *Planta*. 2008 Mar <http://www.ncbi.nlm.nih.gov/pubmed/18026987>
 23. **Electrosensitivity in Sweden.** <http://www.emfacts.com/2009/02/1014-electrosensitivity-in-sweden-by-olle-johansson/>
 24. **Towards Better Health: Switzerland TV Program on Electrohypersensitivity.** 2009. <http://mieuxprevenir.blogspot.com/2013/03/swiss-tv-program-from-2009-on.html>
 25. **‘Wi-fi refugees’ shelter in West Virginia mountains.** 2011. <http://www.bbc.com/news/world-us-canada-14887428>
 26. **Replication of heart rate variability provocation study with 2.4-GHz cordless phone confirms original findings.** Havas, M. *Electromagn Biol Med*. 2013 Jun <http://www.ncbi.nlm.nih.gov/pubmed/23675629>
 27. **Electromagnetic hypersensitivity: evidence for a novel neurological syndrome.** *Int J Neurosci*. 2011 Dec;121(12):670-6. <http://www.ncbi.nlm.nih.gov/pubmed/21793784>
 28. **Review: Electromagnetic hypersensitivity: Fact or Fiction?** Genius, S, Lipp, C. *Science of Total Environment*. Sept 2011. http://www.academia.edu/4125616/Genuis_EHS_paper
 29. **Electromagnetic absorption in the human head and neck for mobile telephones at 835 and 1900 MHz.** Gandi, O. *Microwave Theory and Techniques*. Vol 44, Oct, 1996. <http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=539947>
 30. **International Agency for Research on Cancer. IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic to Humans.** http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf
 31. **Alone Together.** Sherry Turkle. 2012. <http://www.npr.org/2012/10/18/163098594/in-constant-digital-contact-we-feel-alone-together>
 32. **Austrian Medical Association Guidelines- EMF and Electrohypersensitivity.** <http://freiburger-appell-2012.info/media/EMF%20Guideline%20OAK-AG%20%202012%2003%2003.pdf>
 33. **Israeli Ministry of Education issue guidelines to limit Wi-Fi in schools.** 2013 <http://www.gsma.com/publicpolicy/israeli-ministry-of-education-issue-guidelines-to-limit-wi-fi-in-schools>
 34. **France: New National Law Bans Wi-Fi in Nursery School!** <http://ehtrust.org/france-new-national-law-bans-wifi-nursery-school/>
 35. **French government bans advertising of mobiles to children.** 2009 <http://www.independent.co.uk/life-style/gadgets-and-tech/news/french-government-bans-advertising-of-mobiles-to-children-1299673.html>
 36. **Electromagnetic Fields From Mobile Phones: Health Effects on Children and Teenagers.** April 2011. http://www.magdahavas.com/wordpress/wp-content/uploads/2011/06/Russia_20110514-rncnirp_resolution.pdf
 37. **Parliament Assembly European Council EMF Microwave Policy.** 2011. <http://assembly.coe.int/Mainf.asp?link=/Documents/AdoptedText/tal1/ERES1815.htm>
 38. **Why A Leading Professor of New Media Just Banned Technology Use in Class.** Sept 25, 2014. *Washington Post*. <http://www.washingtonpost.com/blogs/answer-sheet/wp/2014/09/25/why-a-leading-professor-of-new-media-just-banned-technology-use-in-class/>
 39. **Princeton/UCLA Study: Its Time to Ban Laptops in Law School Classrooms.** Feb 5, 2015. <http://taxprof.typepad.com/taxprof/blog/2015/02/princetonucla-study-.html>
 40. **Brain Cancer – Mobile phone and cordless phone use and the risk for glioma – Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009.** Hardell. *Pathophysiology*. 2014 Oct 29. <http://www.ncbi.nlm.nih.gov/pubmed/25466607>
 41. **Brain Cancer – Mobile phone use and brain tumors in the CERENAT case-control study.** Coureau G. *Occup. Environ Med*. 2014 Jul; <http://www.ncbi.nlm.nih.gov/pubmed/24816517> 