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United States District Court

District of Oregon

Portland Division

AHM, by and through
her Guardian *ad litem* and father,
David Mark Morrison, and
David Mark Morrison, individually,

v.

Portland Public Schools,

Defendant.

Civil Action No. 3:11-cv-00739-MO

**Declaration of
Dr. Andrew Goldsworthy, BSc, PhD**

I, Dr. Andrew Goldsworthy, BSc, PhD, under penalty of perjury pursuant to 28 U.S.C. § 1746, hereby make the following declaration in support of an injunction against Portland Public Schools' use of WI-FI:

1. After a conventional Grammar School education, I obtained a First Class Honors Degree in Botany followed by a PhD for research into plant physiology and biochemistry at the University of Wales.

2. I went on to lecture in biology at Imperial College London, where I spent the rest of my career. I have had many teaching and research interests, ranging from the biochemistry of photorespiration to the biology of space flight. I retired in 2004, but remain as an honorary lecturer.

3. I was also a scientific advisor to the European Space Agency and continue to be a scientific advisor to several European charities whose work pertains to relationships between the environment and electromagnetic fields and radiation, including the Bio Electromagnetic Research Initiative, the Radiation Research Trust, and Electrosensitivity-UK.

4. I have always had a strong interest in how living organisms use internally generated electric currents to control their growth and metabolism, and in their disruption by externally applied currents, fields and radiation.

5. In my retirement, I have synthesized information from a wide range of scientific journals and created simple layperson's explanations of how weak electromagnetic fields affect us all. The first of these can be found at: <http://tinyurl.com/2nfujj>.

6. I will receive no compensation for my testimony beyond out-of-pocket expenses.

7. **Modern Studies.** There are a number of modern studies that explain that describe the sorts of damage that can occur, e.g. as a result of the peroxidation of polyunsaturated lipids in cell membranes and changes to the nucleic acid metabolism of cells by modulated microwave radiation such as that from cellphones and Wi-Fi. Many describe visible or detectable damage to a wide variety of components in living cells, including DNA. Others describe epigenetic changes in which the existing DNA is modified by keeping the normal base sequence but adding chemical structures to alter its normal function. These alterations survive normal cell division and may even be passed on to subsequent generations. Just how harmful they are remains to be

seen but I would strongly advised the application of the precautionary principle and not to take the risk.

a) Examples of molecular effects caused by cell phone radiation

- i. Ozgur, E., G. Güler, et al. (2010). "Mobile phone radiation-induced free radical damage in the liver is inhibited by the antioxidants n-acetyl cysteine and epigallocatechin-gallate." *International journal of radiation biology*(00): 1-11.
- ii. Gutteridge, J. and X. C. Fu (1981). "Enhancement of bleomycin-iron free radical damage to DNA by antioxidants and their inhibition of lipid peroxidation." *FEBS letters* **123**(1): 71.
- iii. Yan, J. G., M. Agresti, et al. (2009). "Qualitative Effect on mRNAs of Injury-Associated Proteins by Cell Phone Like Radiation in Rat Facial Nerves. *Electromagnetic Biology and Medicine* **28**(4): 383-390.
- iv. Yan, J. G., M. Agresti, et al. (2008). "Upregulation of specific mRNA levels in rat brain after cell phone exposure." *Electromagnetic Biology and Medicine* **27**(2): 147-154.
- v. Simbürger, E., A. Stang, et al. (1997). "Expression of connexin43 mRNA in adult rodent brain." *Histochemistry and cell biology* **107**(2): 127-137.
- vi. Chen, J., H. C. He, et al. (2010). "Effects of Pulsed Electromagnetic Fields on the mRNA Expression of RANK and CAII in Ovariectomized Rat Osteoclast-Like Cell." *Connective Tissue Research* **51**(1): 1-7.

- vii. Currenti, S. (2009). "Understanding and Determining the Etiology of Autism." *Cellular and Molecular Neurobiology* **30**(2): 161-171.
 - viii. Tice, R. R., G. G. Hook, et al. (2002). "Genotoxicity of radiofrequency signals. I. Investigation of DNA damage and micronuclei induction in cultured human blood cells." *Bioelectromagnetics*, **23**(2): 113-126.
 - ix. Lerchl, A. (2009). "Comments on "Radiofrequency electromagnetic fields (UMTS, 1,950 MHz) induce genotoxic effects in vitro in human fibroblasts but not in lymphocytes" by Schwarz et al. (Int Arch Occup Environ Health 2008; doi: 10.1007/s00420-008-0305-5)." *Int Arch Occup Environ Health* **82**(2): 275-278.
 - x. Vijayalaxmi and T. J. Prihoda (2009). "Genetic damage in mammalian somatic cells exposed to extremely low frequency electromagnetic fields: a meta-analysis of data from 87 publications (1990-2007)." *Int J Radiat Biol* **85**(3): 196-213.
 - xi. Sannino, A., M. Sarti, et al. (2009). "Induction of adaptive response in human blood lymphocytes exposed to radiofrequency radiation." *Radiat Res* **171**(6): 735-742.
- b. **DNA repair disruption:**
- i. Brusick, D., R. Albertini, et al. (1998). "Genotoxicity of radiofrequency radiation. DNA/Genetox Expert Panel." *Environ Mol Mutagen* **32**(1): 1-16.
 - ii. Belyaev, I. Y., E. Markova, et al. (2009). "Microwaves from

UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes." *Bioelectromagnetics* **30**(2): 129-141.

iii. Sun, L. X., K. Yao, et al. (2006). "[Effect of acute exposure to microwave from mobile phone on DNA damage and repair of cultured human lens epithelial cells in vitro]." *Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi* **24**(8): 465-467.

c. **Micronuclei formation** - When DNA becomes fragmented inside the cytoplasm, some fragments are not able to recombine properly. Those fragments that can often function well enough, form a membrane around themselves called micronuclei. However, when the cell divides they are usually lost and the daughter cells will be genetically incomplete and probably lose their normal function.

d. **Immune response suppression:**

i. Lyle, D. B., P. Schechter, et al. (1983). "Suppression of T-lymphocyte cytotoxicity following exposure to sinusoidally amplitude-modulated fields." *Bioelectromagnetics* **4**(3): 281-292.

ii. Elekes, E., G. Thuroczy, et al. (1996). "Effect on the immune system of mice exposed chronically to 50 Hz amplitude-modulated 2.45 GHz microwaves." *Bioelectromagnetics* **17**(3): 246-248.

iii. Dabala, D., D. Surcel, et al. (2008). "Oxidative and Immune Response in Experimental Exposure to Electromagnetic Fields." *Electromagnetic field, health and environment:*

proceedings of EHE'07: 105.

- iv. Surcel, D., D. Dabala, et al. (2009). "Free Radicals, Lipid Peroxidation and Immune Response in Experimental Exposure to Electromagnetic Fields." *Epidemiology* **20**(6): S118.
- v. A 2011 study by Buchner and Eger found that, after the activation of a PM MW radiation-emitting base station, the levels of the stress hormones adrenaline and noradrenaline increased significantly during the first six months; the levels of the precursor dopamine decreased substantially. In children, the decrease was somewhat more pronounced than in adults. The initial levels were not restored even after one and a half years. As an indicator of the dysregulated chronic imbalance of the stress system, the phenylethylamine (PEA) levels dropped significantly until the end of the study period. The effects showed a dose-response relationship and occurred well below current limits for technical RF radiation exposures. Chronic dysregulation of the catecholamine system has great relevance for health and is well known to damage human health in the long run.
- vi. In 2010, Augner *et al.* found that that pulse-modulated RF/MW radiation in considerably lower field densities than FCC guidelines can influence salivary cortisol, alpha amylase and immunoglobulin A. They point out supportive findings of a "whole cascade" of biochemical reactions (Friedman 2007) from induction of transcription and other cellular processes to proliferation with such

exposure. Schwartz et al (2008) showed that PM MW radiation at 1.95 GHz could cause genetic alterations in human cells in vitro. They and others observed a significant increase in comet tail factor and centromere-negative nuclei in human cultured fibroblasts, chromosomal instabilities, genotoxic effects, double-strand DNA breaks and effects on the blood-brain barrier. These could lead to severe health consequences.

- vii. A 2011 study shows that children's bodies are more sensitive than adults', and conclude that there are serious harmful effects on cognitive, memory, and other functions in children who are exposed to PM MW radiation by the use of wireless communications devices. Khorseva N. I.

Mechanisms

8. Many people suffer immediately or in the short- or long-term one or more of a wide variety of symptoms when exposed to weak, radiofrequency (RF) radiation, including microwave (MW) radiation, including that from laptops and Wi-Fi.

9. I will explain just how these effects can arise, and virtually all of them share a common mechanism. The evidence fits together and leaves little doubt that the majority of the reported effects are real and must be taken seriously.

10. I have researched the frequently reported effects of RF/MW electromagnetic fields to see if there are any underlying threads that may indicate a common mechanism and then to try to change the characteristics of the signal to minimize these effects. The most important is due to effects on calcium efflux from cell membranes. These include cognitive impairments, early dementia, multiple allergies, DNA fragmentation, loss of fertility, increased cancer risk, and electromagnetic hypersensitivity.

Calcium Efflux Effects

11. Most of the damage done by digital telecommunications is not due to heating but rather by the electrical effect their pulsating signals have on living tissues, which occurs at much lower energy levels.

12. The human body can act as an antenna; and the signals from external RF/MW radiation make electric currents flow through the body in time with the pulsations. It is these that do the bulk of the damage, by destabilizing the delicate membranes that surround each cell and which also divide it into internal compartments such as mitochondria (the energy factories of the cell), and the lysosomes (the cell's recycling factories).

13. All of these membranes are just two molecules thick and have a similar basic structure. They are liquid crystals, made largely of negatively charged molecules (which repel one another) stabilized by divalent positive ions (mostly calcium) that sit in between them by mutual attraction and hold them together like mortar holds together the bricks in a wall.

14. It was first shown by Bawin *et al.* in the 1970s that weak, amplitude-modulated (AM) radio waves, where the strength of the signal rises and falls in modulation at low frequencies, could remove some of this calcium from brain cell membranes. This destabilizes these membranes and makes them more likely to leak. The effects are strongest with modulation in the extremely low frequency (ELF) range and in radio waves that have been amplitude-modulated with ELF. Pulse-modulation is an extreme form of amplitude modulation, where the signal goes entirely off for a short period of time, resulting in bursts of energy.

15. The low-frequency pulsations of Wi-Fi infrastructure and Wi-Fi laptops will behave in much the same way upon biologic tissues. This is important in the brain, because the normal function of brain cells depends on the controlled passage of specific ions through their membranes. When these membranes leak, ions flow through them in a relatively uncontrolled way, which results in brain hyperactivity and may cause result in attention deficit hyperactivity disorder (ADHD) in some people. When this occurs in the brain of a fetus or young child, it

prevents normal brain development, which may result in autism (<http://mcs-america.org/june2011pg2345.pdf>), as discussed further below. Wi-Fi should therefore be considered as an impediment rather than an aid to learning and may be particularly hazardous for children and pregnant teachers.

Modulation

16. In theory, unmodulated radio and microwaves should not release calcium from cell membranes; because there is not enough time to replace the calcium with another ion before the field reverses. However, as shown by Bawin *et al.* (1975) calcium release does occur if the RF/MW signal is modulated at biologically-active low frequency, which suggests that living cells can demodulate it. The simplest way to demodulate a signal is to rectify it. Living cell membranes contain countless voltage-gated ion channels that open only when voltage across the cell membrane reaches a pre-determined value. These can rectify low-frequency signals but, because they require the mechanical opening and shutting of the channels, cannot work at MW frequencies. However, any ion channel, provided it is open at all, should be able to rectify, even at MW frequencies, due to the presence of the membrane potential. The membrane potential is a natural voltage of the order of 100mV across living cell membranes, which gives a voltage gradient of about 10 million volts per meter along each ion channel (which is about 10nm long). This voltage gradient gives the channel different electrical properties in either direction. In effect, the whole membrane behaves as an array of point contact Schottky diodes, which allows even MW signals to be rectified and demodulated. The extracted low frequencies then appear across the membrane, where they can do most damage. This principle has been nicely illustrated by the construction of a complete radio set from a single carbon nanotube having a similar diameter to an ion channel (see <http://tinyurl.com/m4u75o>). When a voltage gradient was applied along the tube it could both **amplify** and **demodulate** a radio signal, even at MW frequencies. We should therefore not be surprised to find that the human body can extract biologically active and potentially damaging low frequencies from weak Wi-Fi

radiation and that such radiation, when continued throughout the school day, and perhaps overnight at home, presents a serious threat to many children.

Consequences of Leaky Cell Membranes

17. **Immediate Effects on the Blood Brain-Barrier** – The brain is separated from the bloodstream by a barrier in which the gaps between the cells are normally sealed by ‘tight junctions,’ which prevent unwanted materials entering the brain. Exposure to pulse-modulated MW radiation, such as WI-FI deploys, can breach this barrier to allow toxic materials such as albumin in the blood to enter, which can kill neurons (Salford *et al.* 2003). Prolonged exposure will cause progressive brain damage and may be partly responsible for the increase in early dementias and Alzheimer’s Disease. This could be due to these materials leaking through perforated cell membranes or to an opening of the tight junctions themselves.

18. **Effects on Metabolism** – The concentration of calcium in the cytosol (the main part of living cells) is extremely low, usually much lower than that outside. If the external membrane leaks, free calcium enters the cell, where it has many effects on metabolism. It may stimulate growth and repair (which may account for the apparent short-term beneficial effects of certain electromagnetic fields) but can also initiate several stress responses and inhibit cell growth.

19. **Cardiac Arrhythmia** – The heart muscle contracts in response to a wave of electrical activity passing through it, which is what we see in an electrocardiogram. This is generated by an ordered exchange of ions across its cell membranes. When these membranes leak as a result of electromagnetic exposure, this electrical wave becomes weakened and disordered, which can result in cardiac arrhythmia and risk of a heart attack. It is not surprising that the introduction of Wi-Fi into public schools has seen a concomitant increase in reports of cardiac irregularities in children.

20. **Effects on Allergies** – There are similar tight junction barriers protecting all of our body surfaces, including the skin (in the *stratum granulosum*¹) and the linings of the lungs, nose and gut. These normally stop foreign chemicals and allergens entering the body, but if electromagnetic radiation were to open these barriers too, it could explain the current increase in a variety of illnesses, including asthma showing increasing asthma risk, multiple allergies, autoimmune disorders such as multiple sclerosis, and multiple chemical sensitivities. More recently, this has been confirmed by a 2011 study showing an increased risk of asthma in children born to mothers exposed to magnetic fields (Li et al. 2011) More on these, including references is discussed in my paper, *The Cell Phone and the Cell: the Role of Calcium*, Goldsworthy, A. (2008) (I hereby adopt and incorporate herein the findings in this paper) http://www.hese-project.org/hese-uk/en/papers/cell_phone_and_cell.pdf. Calcium release is probably involved in these effects, since low external calcium or EGTA (a substance that removes calcium ions from surfaces) increase the permeability of respiratory epithelia to ions and particles as large as viruses.

21. **Effects on the Skin** – If many cells leak some of their contents into the surrounding matrix, it will cause inflammation which is a normal response to cellular damage. The redness is due to an increased blood supply needed to effect a repair and it also activates the immune system in an attempt to fight off possible pathogenic attack. Rashes of this sort have frequently been associated with electromagnetic exposure and radiation from some computer screens. When it occurs, it is a clear indication of cellular damage has and raises the possibility that there may be further but less obvious damage to the cells. Anyone suffering this should



Michrowski, A.,
Electromagnetic fields: High-level microwave technology concerns, 2011,
<http://media.withtank.com/42391c31ef.pdf>.

immediately take steps to minimize his exposure since it seems to get worse with repeated exposures.

22. **Effects on hormones** - Of particular interest is the Eskander 2011 study, in that it showed a **highly significant** reduction in both T3 and T4 (thyroid) hormones after prolonged exposure to cell phone base station RF/MW radiation, which is similar to, but by way of exposure levels, not quite as harmful as school WI-FI radiation. This would be expected to result in hypothyroidism, the main symptoms of which are fatigue and obesity. Indeed, society's almost universal exposure to such RF/MW radiation could be held **responsible, at least in part, for the current epidemic of what is often diagnosed as chronic fatigue syndrome and obesity**. Obesity in itself is associated with many other illnesses such as diabetes, cardiac conditions, kidney failure and cancer. Members of the public might find it particularly galling to be told that obesity (which may result in having to go on a lifelong diet) is their entire fault for eating too much, when a considerable amount of the blame for it lies with the telecommunications industry.

Autism

23. **What is Autism** - Autism is a group of life-long disorders (autistic spectrum disorders or ASD) caused by brain malfunctions and is associated with subtle changes in brain anatomy (see Amaral *et al.* 2008 for a review). The core symptoms are an inability to communicate adequately with others, abnormal social behavior, with poor verbal and non-verbal communication, unusual and restricted interests, and persistent repetitive behavior. There are also non-core symptoms, such as an increased risk of epileptic seizures, anxiety, and mood disorders. ASD has a strong genetic component, occurs predominantly in males and tends to run in families; however, it can also be induced by environmental factors after birth.

24. **Genetic ASD may be caused by calcium entering neurons** - Some genetic forms of ASD can be accounted for by known mutations in the genes for ion channels that result in an increased background concentration of calcium in neurons. This would be expected to lead

to neuronal hyperactivity, the formation of sometimes unnecessary and inappropriate synapses, which in turn can lead to ASD (Krey and Dolmetsch 2007).

25. **Electromagnetic fields let calcium into neurons** - There has been a 60-fold increase in ASD in recent years, which cannot be accounted for by improvements in diagnostic methods and can only be explained by changes in the environment. This increase corresponds in time to the proliferation of mobile telecommunications, Wi-Fi, and microwave ovens as well as extremely low frequency fields (ELF) from mains wiring and domestic appliances. We can now explain this in terms of electromagnetically-induced membrane leakage leading to brain hyperactivity and abnormal brain development. The most potent source of such environmental exposure, in terms of frequencies, power densities and durations to a schoolchild with Wi-Fi at his or her school would be the compulsory, continuous and close range radiation from the school system.

26. **RF/MW radiation makes cell membranes leak** - As mentioned previously, an effect of RF/MW radiation is to generate small, alternating voltages across the cell membranes, which destabilize them and make them leak. This can have all sorts of consequences, as unwanted substances diffuse into and out of cells unhindered, and materials in different parts of the cell that are normally kept separate, become mixed.

27. **Why weak RF/MW fields are more damaging than strong ones** – As mentioned previously, we have known since the work of Suzanne Bawin and her co-workers (Bawin *et al.* 1975) that modulated RF/MW electromagnetic radiation that is far too weak to cause significant heating can nevertheless remove calcium ions (positively charged calcium atoms) from cell membranes in the brain. Later, Carl Blackman PhD of EPA showed that this also occurs with ELF electromagnetic radiation but only within one or more “*amplitude windows*,” above and below which there is little or no effect (Blackman *et al.* 1982; Blackman 1990). A proposed molecular mechanism for this can be found in Goldsworthy (2010), which is adopted and incorporated by reference herein. In particular, it explains *why weak*

electromagnetic fields can have a greater effect than strong ones and why prolonged exposure to weak fields (where cells are maintained in the unstable condition for longer) is potentially more damaging than relatively brief exposure to much stronger, e.g., measurable heat-producing, ones.

28. **How calcium ions stabilize cell membranes** - This loss of calcium is important because, as mentioned previously, calcium ions bind to and stabilize the negatively charged membranes of living cells. They sit between the negatively charged components of the cell membrane and bind them together rather like mortar binds together the bricks in a wall. Loss of just some of these calcium ions destabilizes the membrane and makes it more inclined to leak, which can have serious metabolic consequences. Among these are the effects of membrane leakage on the neurons of the brain as described in my “Cell Phone and the Cell article”.

29. **How membrane leakage affects neurons.** Neurons transmit information between one another in the form of chemical neurotransmitters that pass across the synapses where they make contact. However, the release of these is normally triggered by a brief pulse of calcium entering the cell. If the membrane is leaky due to electromagnetic exposure, it will already have a high internal calcium concentration as calcium leaks in from the much higher concentration outside. The effect of this is to put the cells into hair-trigger mode so that they are more likely to release neurotransmitters and the brain as a whole may become hyperactive (Beason and Semm 2002; Krey and Dolmetsch 2007, Volkow *et al.* 2011). This may not be a good thing; since the brain may become overloaded, leading to a loss of concentration and what we now call attention deficit hyperactive disorder (ADHD).

30. **How does this impact on autism?** - Before and just after its birth, a child’s brain is essentially a blank canvas, and it goes through an intense period of learning to become aware of the significance of all of its new sensory inputs, e.g. to recognize its mother’s face, her expressions and eventually other people and their relationship to him/her (Hawley & Gunner 2000). During this process, the neurons in the brain make countless new connections, the

patterns of which store what the child has learnt. However, after a matter of months, connections that are rarely used are pruned automatically (Huttenlocher & Dabholkar 1997) so that those that remain are hard-wired into the child's psyche. The production of too many and often spurious signals due to electromagnetic exposure during this period will generate frequent random connections, which will also not be pruned, even though they may not make sense. It may be significant that autistic children tend to have slightly larger heads, possibly to accommodate unpruned neurons (Hill & Frith 2003).

31. Because the pruning process in more electromagnetically-exposed children may be more random, it could leave the child with a defective hard-wired mind-set for social interactions, which may then contribute to the various autistic spectrum disorders. These children are not necessarily unintelligent; they may even have more brain cells than the rest of the population; and some may actually be savants. They may just be held back from having a normal life by a deficiency in the dedicated hard-wired neural networks needed for efficient communication with others. The very hard-wiring of the brain also informs us how and why the hard-wiring of technologic devices is advantageous: hard-wiring carries a signal with efficiency and integrity. By contrast, the degradation of the neural myelin sheath, which is protective, lipid insulation for the body's natural electrical impulses, produces a loss of motor control. Similarly, the carriage of a technologic communications signal through the atmosphere and many absorbent bodies in the environment, rather than through an insulated wire, requires far more energy and results in slow, sometimes incorrect processing, not to mention the vulnerability to an unintended another's receipt of the information, as in surveillance or hacking.

32. Effects on the peripheral nervous system are equally damaging since hyperactivity here causes sensations such as pain, heat, cold, and pins-and-needles in some people (i.e. symptoms of electromagnetic hypersensitivity). Hyperactivity in the cells of the inner ear can cause tinnitus and affect the sense of balance causing dizziness and symptoms of motion sickness, including nausea. School children and staff showing any of these symptoms

should be treated with sympathy and the WI-FI switched off in the school.

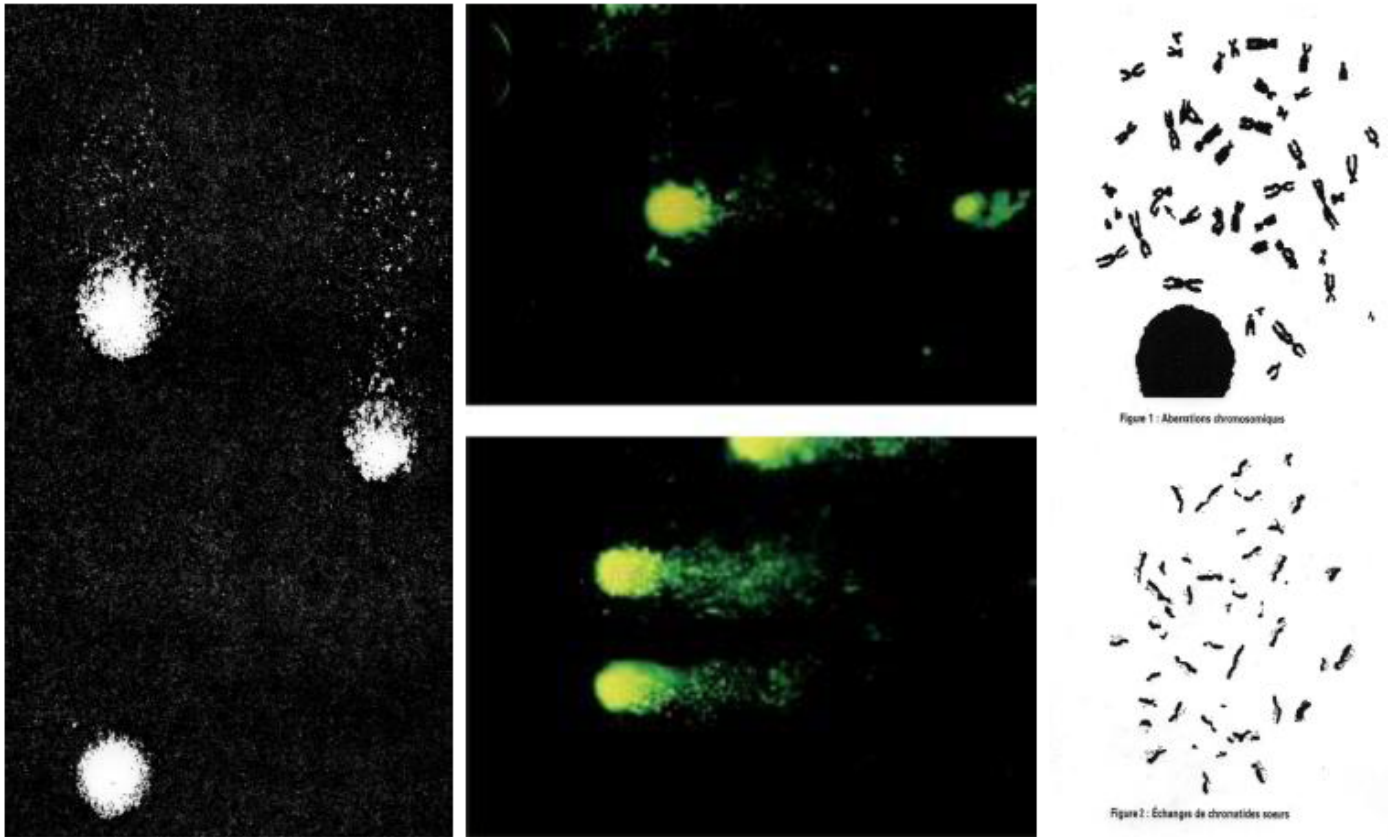
33. Lai and Singh demonstrated in replicated studies through the 1990s cognitive impairments in rats exposed to subthermal-level MW radiation, and demonstrated as well mechanisms therefore; and Erdinc (2003) and Lopez-Martin (2006) induced seizures at low dosages of MW radiation. Fragopoulo (2009) showed cognitive deficits that remained at least a day after a 2 hour/day exposure for four days to PM MW radiation. In humans, Maby 2006 found that epileptics had a significant increase in EEG signal energy when exposed to short-term PM MW radiation.

34. Many other effects on health can be attributed to membrane leakage, including damage to DNA due to the release of reactive oxygen species (ROS) from mitochondria, and digestive enzymes from lysosomes.

DNA

35. **DNA Fragmentation** - Many experiments have shown both single and double stranded DNA breakage in cell cultures after several hours of cell phone radiation (Lai and Singh 1995, Deim *et al.*).

36. Although DNA molecules are too stable to be damaged directly by non-ionizing radiation, they can still be damaged indirectly as a result of enzyme leakage from lysosomes. Lysosomes are membrane bound structures in the cells of most higher organisms that normally digest waste for recycling. They contain many digestive enzymes, including DNase, which destroys DNA. Were these to leak as a consequence of electromagnetic exposure, we would expect to see DNA fragmentation and possible collateral damage to other cellular components. Cells that have been affected in this way lose some of their normal function and also have an increased risk of becoming cancerous.



Top: A comet assay of a normal cell shows little DNA damage. Bottom: The same assay of cells exposed to microwave radiation shows "tails" of damaged DNA. Michroski, A., *Electromagnetic field: High-level microwave technology concerns*, from Henry Lai, at 7, 2011. The assay gets its name from the appearance of a damaged cell that takes on the appearance of a comet, with the bits of damaged DNA forming the tail. The longer the tail, the more damage has resulted.

37. Such DNA damage can cause a loss of fertility and an increased risk of getting cancer and in some cases, could lead to abnormalities in future generations. Most of the studies have been based on epidemiology since it is unethical to do controlled experiments on humans. ***The human genome, which has taken countless millions of years to evolve, is now under very serious threat.*** We are talking about the future of our society.

38. Many factors in addition to genetics contribute to whether an individual suffers adverse health outcomes. Due to the sheer complexity of all living systems and the importance of ion-flow (electric currents) in their normal metabolism, not everyone will suffer the exactly the same symptoms and there is no guarantee that even those that do not show obvious symptoms at

the moment will remain so or that no hidden damage or loss of fertility that will appear at a later date. For this reason, Wi-Fi is entirely inappropriate in schools, particularly since a safe alternative, corded Internet, is readily available and inexpensive.

39. **There is an even more worrying line of research** because we also see biological effects in water lines “conditioned” with a weak electrical signal. Goldsworthy, *et al.* (1999) showed that ordinary town water supplies, when treated with pulsed radio frequencies (as used to remove lime scale from plumbing) becomes biologically active in yeast, probably by removing calcium from cell membranes. The results were broadly similar to those of direct exposure to electromagnetic fields and is what prompted me to conclude that calcium removal from cell membranes was a likely mechanism for most of the observed biological effects on animals. **The chilling possibility to emerge from this is that the biological effects of electromagnetic fields can be transmitted in the bloodstream and exposure in any part of the body could have an effect all over the body, not just the parts that are directly exposed. Nowhere in the body is safe from the effects of the radiation. No part of the body should be exposed to it.**

41 As someone who has studied the effects of electromagnetic radiation on animals and humans for many years, my advice is for all schools that have Wi-Fi equipment to remove it immediately, replace it with cable, and disable the Wi-Fi on any laptops that they wish to retain (quite easy to do given the schools have existing operating Ethernet systems).

42 It is my belief that the use of Wi-Fi in Portland Public Schools is and will continue to have adverse health effects on AHM, other students, school staff and faculty and should be discontinued immediately.

Dated this 19th day of December, 2011.

/s/ Dr. Andrew Goldsworthy

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Curriculum Vitae – 2011

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Degrees:

B.Sc. (Wales) First Class Honours in Botany (1960).

Ph.D. (Wales) Plant Physiology and Biochemistry (1964).

Membership of Professional Bodies:

Society for Experimental Biology.

Appointments:

Lecturer at Imperial College from 1963 to 2004 (Now Retired)

This includes a six-month sabbatical in the **Genetics Dept. of the Connecticut Agricultural Experiment Station** (1970) working on somatic hybridisation and new methods to measure photosynthesis and screen for plants with a C₄ capability.

There was also an eighteen-month secondment with **RHM Research Ltd.** (1975-1976) where I successfully developed electronic instrumentation to measure seed vigour and to predict crop-yield.

Publications

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