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Dr. Frank L. Till, Jr., Superintendent
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Broward County School Board
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Dr. Robert Parks
Ms. Lois Wexler
Broward School District Safety/Risk Management Director

Dear School Board members:

I am a retired physicist who has been concerned about the potential health implications of the “wireless revolution” for several years. Prior to 1994, I was a staff scientist at Argonne National Laboratory near Chicago. Prior to that time, I was a staff member of several federal and private research institutions in Tennessee and California. I am a member of both the American Physical Society and the Institute of Electrical and Electronics Engineers (IEEE). In addition, my biography is listed in both American Men and Women of Science and Who’s Who in Science and Engineering. In addition to my regular career, I have been a part time professor at a junior college in Illinois and (28 years earlier) at a state university in California. In addition, I have served as an expert witness, and I have served on a peer review panel for a federal government agency. Further, I am one of the cofounders of the EMR Network, a national nonprofit organization of volunteers who try to educate the public and federal, state, and local officials about the health hazards of the “wireless revolution” and help people who are adversely affected by this technological movement. I am aware that you are currently considering whether to install computers equipped with wireless Local Area Networks

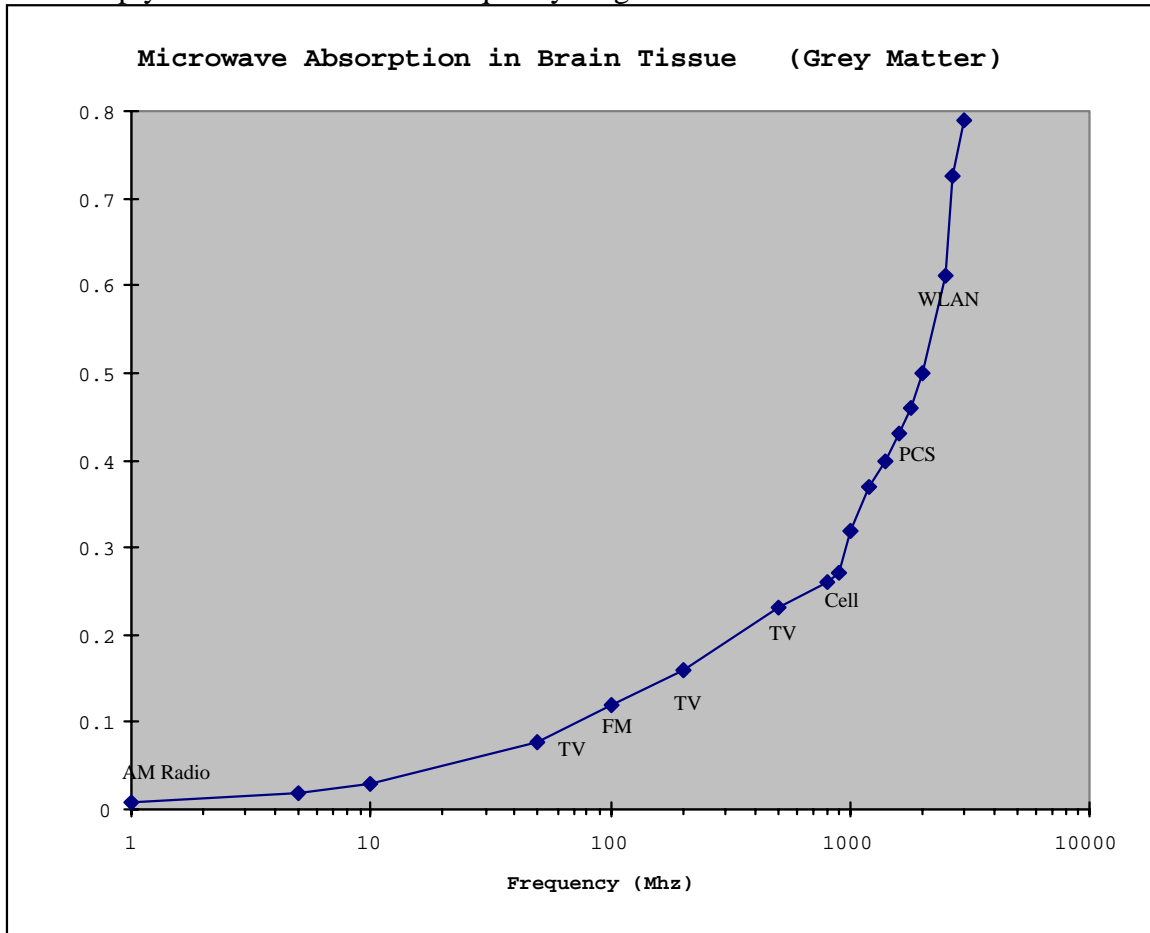
(LAN's) in your schools. Accordingly, I would like to share with you my concerns about the use of these computer systems in classrooms attended by young children.

The present Federal Communications Commission (FCC) guidelines for RF safety and health are used by the telecommunications industry to proclaim the safety of their products, based solely on the concept that one must protect people against heating of their biological cells. Many researchers believe that harmful biological effects can and do occur at radiation levels hundreds and even thousands of times less than the present FCC safety limits. Also, the three engineering standards commissions that advise the FCC concerning safety standards for radiofrequency (RF) radiation will meet again in 2002. After they submit their recommendations, the FCC will probably issue revised guidelines for safety of wireless systems by 2006. The current FCC guidelines were based entirely on research prior to 1986. The new guidelines should benefit from a decade and a half of additional research, much of which has demonstrated significant biological effects from RF and microwave radiation at radiation intensity levels far, far lower than those at which the radiation is a thermal hazard. Thus, you have to be concerned about the possibility that wireless LAN's based on today's safety guidelines will not conform to future guidelines.

To give you some technical details, I have looked into the Apple iMac Air Port system, specifically, but other competitive systems constitute similar threats to the health of children, in my opinion. The Air Port is Apple's name for technology developed by Lucent Technologies. This system uses a PCMCIA card that plugs into the side of the computer. This card contains a wireless modem that transmits at a frequency of about 2.5 Ghz (the frequency of microwave ovens). The antenna on this card has a gain of 5 decibels, which means that its radiation is broadcast almost equally in all directions, but the radiation coming straight out from the card is in the preferred direction, and it is about 3 times stronger (more intense) than the radiation broadcast in other directions.

I have assumed that a child sits about 1.5 feet away from the computer. This system allows no more than 8 computers to interact simultaneously with a single base station (to prevent interference between the different computers sending and receiving data, so the child will only receive any significant amount of radiation from his/her individual computer. However, in a classroom using these computers, there will probably be more than one base station with its set of 8 slave computers - provided interference can be avoided - perhaps by using a different band of frequencies for each base station and slave computers combination (just a guess). Thus, it seems likely to me that a child may get more radiation than just that from his/her own computer. However, I have made a conservative estimate of the total amount of radiation density that a child will likely receive from his/her own computer, accounting for all the directions along which electromagnetic waves emerging from the Air Port's antenna can reach the child. The estimated radiation density is 6-9 microwatts per square centimeter. It seems unwise to me to subject a child on a long term, frequent use basis to this much radiation, especially at the extremely high frequency that was stated. While this radiation intensity is far less than the intensity that will cause biological cell heating, it is well within the range of intensities at which biological effects have been observed in the laboratory and in epidemiological studies of people who live near FM radio and TV broadcast installations. Further, the wireless LAN frequency is so high that the absorption of the radiation into

human tissue is more severe than would be true at lower frequencies. The graph on the next page is a plot of the absorption coefficient of brain tissue for RF radiation. Note how steeply the curve rises in the frequency range of wireless LAN's.

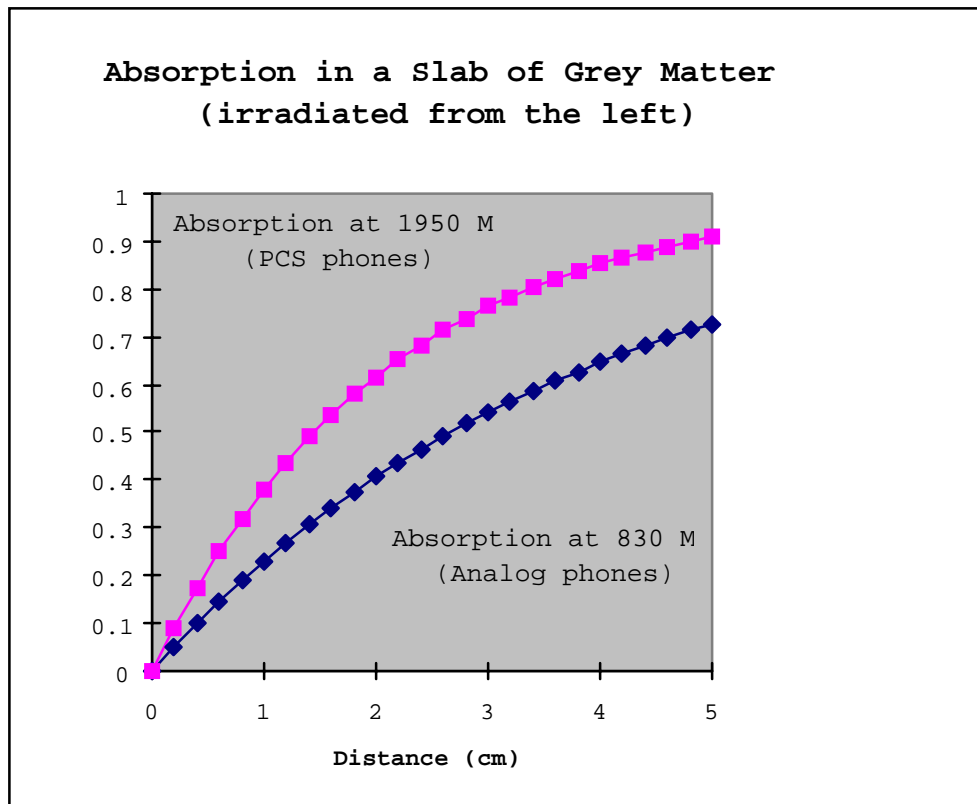


I prepared this graph, using an equation from J.A. Stratton's book *Electromagnetic Theory*, McGraw-Hill, New York (1941). The calculation required human tissue dielectric properties obtained from Air Force report AL/OE-TR-1996-0037 "Compilation of the Dielectric Properties of Body Tissues at RF and Microwave Frequencies" by Dr. Camelia Gabriel of the University of London. Gabriel's study was done for Brooks Air Force Base in Texas, and her results have also been published in three successive articles in *Physics of Medicine and Biology*, vol. 41, No. 11, pp. 2231-2293 (1996).

The significance of this plot is the following: At very low RF frequencies - like the frequencies associated with AM broadcasting - radio waves mostly pass through human tissue with very little absorption. Unless you are very close to a very powerful transmitter, there is very little danger that you will be physically affected by such radiation. As the frequency gets ever higher, a larger fraction of the incident radiation will be absorbed at a specific distance into the tissue. For example, the absorption coefficient for brain tissue is about twice as high for PCS digital phone frequencies 1600-1900 Mhz or 1.6-1.9 Ghz) as it is at analog cellular phone frequencies (800-900 Mhz).

The wireless LAN's that Lucent developed operate at frequencies of about 2.5 Ghz, and the absorption coefficient at that frequency is about 50% higher than at PCS frequency.

Another way to understand this is to look at how radiation might penetrate into a (one dimensional) slab of simulated brain tissue. The plot on the next page shows the absorption profile for the two different values of absorption coefficient for PCS phones and analog cellular phones.

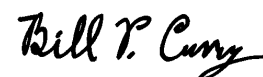


You can see that about 40 % of the incident radiation has been absorbed at the penetration distance of 2 cm for analog phones, and about 65% of the incident radiation has been absorbed at the same distance for PCS phones. I have not computed a similar curve for the frequency (2.5 Ghz) that corresponds to the Air Port Wireless LAN, but I can make an educated guess and say that about 80 % of the incident radiation will have been absorbed at 2 cm for the larger absorption coefficient appropriate for 2.5 Ghz radiation. This means that the energy deposition profile from the edge of the brain inward will be more localized at the higher absorption coefficients. Low frequencies will pass right on through the slab; high frequencies will be absorbed within progressively shorter penetration distances, as the frequency increases. I think that the steepness of the absorption profile in human tissue is a pertinent factor when considering the potential for adverse health effects at such high frequencies.

Dr. Ross Adey, University of California at Riverside faculty member and eminent biological researcher, has warned that children are more vulnerable than adults to adverse effects of microwave radiation for at least two reasons: 1) their brains are smaller than adults and still developing and 2) their hormonal systems are rapidly changing. I have additional concerns that, as frequencies go higher, there is some likelihood of absorbing radiation into natural energy storage modes of complicated organic molecules that are most significant to life. Already, Henry Lai and his coworker N.P. Singh at the University of Washington in Seattle have discovered DNA molecule breakage occurs when rat brain cells are irradiated with 2.5 Ghz radiation at absorbed radiation levels considered "safe" by the FCC. Jerry Phillips (formerly at the bioelectromagnetics laboratory associated with Loma Linda University in Southern California) has performed similar experiments at cellular phone frequencies and found similar results, but the absorbed radiation levels were almost 700 times lower than the FCC safe limit. Further, a neurological group in Sweden have noticed significant reduction of the blood - brain barrier at absorbed radiation levels as much as 4,000 times lower than what the FCC considers safe. The blood - brain barrier protects the brain from the incursion of harmful substances that may be circulating in the blood stream - infectious agents and harmful chemical substances. Reduction of the blood - brain barrier is a potential factor in both cancer formation and neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease, and it has been implicated in causing headaches to frequent cell phone users who have long conversations.

While much research still needs to be done (and probably won't be, on account of lack of funding). I feel that wireless LAN's should be kept out of the classroom, and I urge you to make a similar decision. Thank you for considering my views on this subject.

Sincerely yours,



Bill P. Curry, Ph.D.
Consulting Physicist

