

Should Wi-Fi be used in classrooms?

By Lynn Quiring

For years parents, teachers, administrators, and school boards have fought to keep cellular telephone transmitters away from their schools. Now we are installing them right into the classroom with Wi-Fi base stations.

The hot new craze in Internet access is Wi-Fi and its soon-to-be big brother Wi-Max. Wi-Fi is a wireless connection that allows users to access the Internet without the computer being connected to a cable. And yes, it's very convenient. Imagine walking from the sofa to the bedroom with your laptop and never losing your connection. Imagine the freedom and flexibility afforded schools and office workers. No more ugly bothersome cables to tie you down. You're free to roam the Internet with your fingers while roaming your home, school, or office with your feet. Freedom to move and freedom to surf. Perfect for the individual who is on the go and up-to-date with the latest technology. You can even have free Internet access at your local coffee shop. Same for airports. What a great idea. Or is it?

What exactly is Wi-Fi?

Wi-Fi is a common term that stands for "wireless fidelity." It simply means that a computer can access the Internet without wires or cables. In other words, it allows one to have a wireless connection to the Internet. It's like taking a cell-phone base station and placing it in your home, schoolroom, or office area. Wi-Fi is basically the same type of connection as used to operate a cell phone.

Wi-Fi is really very similar to your cell phone. Radio signals are transmitted from the computer or Bluetooth device to a wireless router, sometimes called a wireless access point (WAP) or wireless local area network (WLAN). The router then sends the signal to the Internet through a cable modem. So this router or wireless access point is really the device responsible for transmitting the harmful radio waves. Any number of computers or devices can be configured to connect to one wireless router to make Internet connections. The workable distance is about a range of 300 feet or more from the wireless access point while most distances for good connections are

maintained at about 100 feet. And, of course there are many variables that can affect this connection. Laptop computers and personal digital assistants (PDAs) are the most common devices utilizing Wi-Fi technology.

Wi-Fi emits radio frequencies

Wireless connections emit radio frequency signals, or radiation, just like cell phones, cell-phone towers, and other wireless devices. Wi-Fi usually transmits its signal at frequencies in the range of 2.4GHz to 5 GHz. Cordless phones often transmit in the 2.4GHz to 5 GHz range, too, and this often causes the cordless phone to interfere with a wireless internet connection to a nearby computer. The Wi-Fi frequency is considerably higher than the frequencies used for cell phones, which operate in the 850 MHz to 1900 MHz range. This higher frequency allows more data to be carried. However, as we'll see later, it is not the frequency of the signal that may do damage to our health. So the higher Wi-Fi frequency isn't really the issue at all when it comes to health considerations.

Wi-Fi hotspots now in schools

Wi-Fi has become popular in the home, office, the airport, and coffee shops. Many cities are now installing "hot spots" where one can take a laptop computer and freely access the Internet over the provided network. This is what is known as a "hot spot." It's a place to make a wireless connection to the Internet. And they are springing up everywhere. Entire cities are becoming wireless allowing one to connect to the Internet from anywhere in the city. And due to the ease of convenience, Wi-Fi connections in schools are now becoming quite popular, too. No longer are computers hard-wired to a connection in a classroom. Connections are now virtual and allow the user, student or teacher, the freedom to connect anywhere in the school without the burden of being restricted by cable connections.

Why wireless connections can be harmful

There are two potentially harmful mechanisms in which Wi-Fi users, including school children, may be harmed. The first mechanism involves the exposure to radiation from the distance or proximity of the user to the computer monitor. This form of exposure originates from the electromagnetic field being

given off by the monitor itself and has nothing to do with the wireless connection. Electromagnetic radiation is given off by the computer screen regardless of whether the connection is wired or wireless. Any and all computer screens produce electromagnetic radiation. These electromagnetic fields can be substantial in strength and can reach levels much higher than the 1 milligauss (1 mG) threshold level of exposure recommended by experts as being safe. Such a field can easily be measured with an inexpensive instrument called a gauss meter.

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The second mechanism of harm comes from the radiation or radio wave itself. The wireless signal, oscillating at 2.4 to 5 GHz, moves much too fast for the body to recognize. So this wave isn't doing the damage. However, anytime any data or information is transmitted, say through our voice, through text messages, or through the sending of information, the data is packaged and "piggy-backed" onto the first wave. This creates a second carrier wave and this wave is called the information-carrying radio wave, or ICRW. It is the information-carrying radio wave that is producing the harm. Here's how this happens. This second carrier wave, or ICRW, oscillates in a much lower Hertz (Hz) range that is easily recognized by the body. When the ICRW comes in contact with the body, the body recognizes this wave and responds to it as if this carrier wave were some type of foreign invader. When this happens certain physiologic changes occur which are very significant. First, at the cellular level, the cell membrane changes and becomes less permeable. This occurs because the active transport channels shut down as the cell goes into a protection mode. This loss of permeability means nutrients can't get inside the cell where they are needed. In other words, the cell doesn't get nourished.

Conversely, since the cell membrane is now less permeable, the toxins and free radicals that build up inside the cell as a natural part of our daily metabolism can't get out. The buildup of toxins and free radicals inside the cell causes other problems. These toxic products damage the mitochondria

inside the cell. If you'll remember from biology class, the mitochondria are where energy for the body is produced. When this energy-producing process is damaged the cell begins to lose its ability to function.

In addition, cells lose their ability to communicate with one another. When one cell can't communicate with another cell and messages don't get sent or received, the body can't respond properly to any type of stress, injury, or invasion. Furthermore, the DNA inside the cell becomes damaged. Fragments of DNA break off and form something called micronuclei. Micronuclei are precursors to cancer formation. And when enough energy is lost and when enough malnourishment occurs, the cell eventually becomes dysfunctional and dies. When enough cells die the tissues are affected. When enough tissue is affected organs become damaged and don't work properly. And the cascade of damaging events begin that can lead to a multitude of symptoms and failure of the body's defense mechanisms to act appropriately.

The Wi-Fi problem

Think of Wi-Fi this way. It's really nothing more than a small version of a cell phone tower placed in the classroom or office. Or, it could be similar to having a cordless phone in your home with multiple handsets throughout the house. The base station is the access point and all the peripheral phones connect with it wirelessly. The radio frequency radiation being emitted is the same. The information-carrying radio wave is being transmitted continuously 24 hours a day. The connections from the computers and other wireless devices throughout the school, office, or home to the wireless access points cause any user around them, (children, teacher, staff, etc.) to be continuously exposed. Everyone in the building is caught in the crossfire of the continual access to the wireless access points. Even non-users are exposed because of the blanketing effect of these wireless access points throughout the building. So no one escapes the exposure.

In understanding the danger of Wi-Fi we must remember that it is not the type of device, in this case a wireless access point or router that is important. Rather it is the type of radio frequency radio waves that are being produced by the device that are significant. Whether from a wireless router, a cell phone, a cell phone tower, or personal digital assistant (PDA), electromagnetic frequencies are produced by all these devices. We must look at the technology being used by these devices and not the device itself as the problem. This should be the primary concern as we evaluate their safety, particularly in the classroom.

Another important aspect of Wi-Fi exposure is that of modulation. Modulation refers to whether or not the signal frequency is constant or pulsed. The new digital cell phones operate on a pulsed frequency, as does all wireless technology. Studies have shown that these pulsed signals are a greater risk than analog, non-pulsed signals.

Certainly, by the addition of any type of wireless we are adding to the burden of electropollution we are all currently exposed to. Special consideration should be given to the additional exposure that Wi-Fi technology would bring to those in a classroom, including the teachers, staff, and certainly students.

Children are more vulnerable

Concern about the increased vulnerability to electropollution by children has valid reasoning. Since the skull bones of the head don't fully harden until about age 22, the skull bones of a child's head are softer than that of an adult. A softer head bone translates to easier penetration through the skull and into the head by radio frequency radiation. Furthermore, the head of a child contains more water since the brain is not fully developed. It would make sense then that water will act as a conductor to electromagnetic radiation increasing the possibility of even further damage. And since a child's brain and nervous system is still developing, it only stands to reason that the potential damage would be greater since cells that are in a growing phase are more easily damaged.

And finally, exposing children in the elementary schoolroom will add to both the amount of electromagnetic radiation exposure and the accumulated length of exposure over their lifetime that they will be exposed. No one can argue that the children of today's generation will be exposed to far greater amounts of electromagnetic radiation and will be exposed to it for a much longer period of time than any generation before. We simply don't know the consequences of this increased and cumulative exposure. And it's an experiment that we shouldn't place our children in. Why set up these networks without understanding any of the long-term consequences? Did we not learn a lesson from the tobacco and asbestos industries?

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References available on request. Part 2 of this report will appear in the October issue of *Teacher*.

