

The background of the slide is a close-up photograph of green leaves, likely ivy, with some leaves showing signs of aging or damage. The leaves are layered, creating a sense of depth and texture. The lighting is soft, highlighting the veins of the leaves.

Mobile Device Usage: More, more, more or Less, less, less?

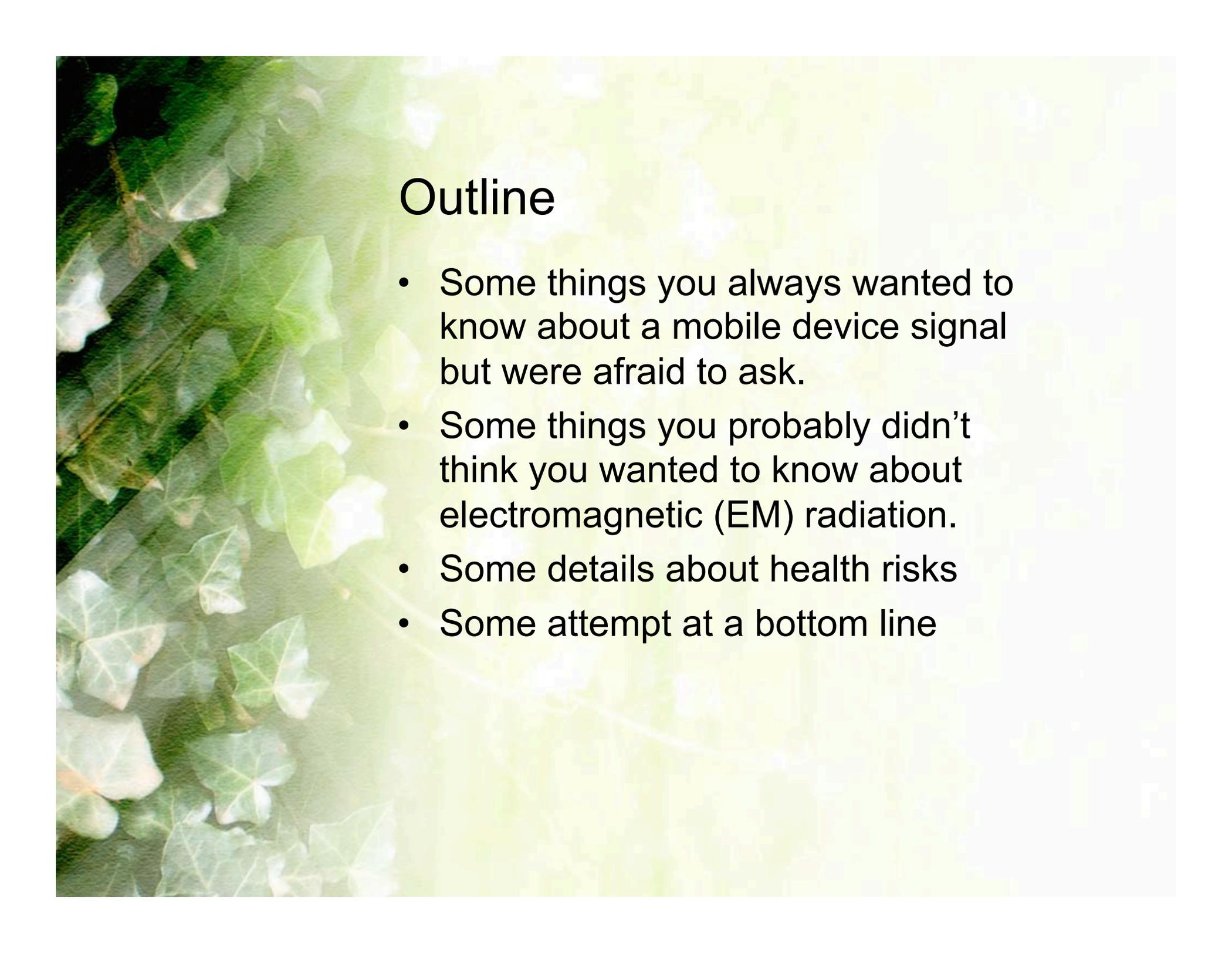
Denise Wilson & Cassandra Hooper
University of Washington – Seattle

In collaboration with
Coming Alongside -- Environmental Services

National Environmental Health Association
Conference

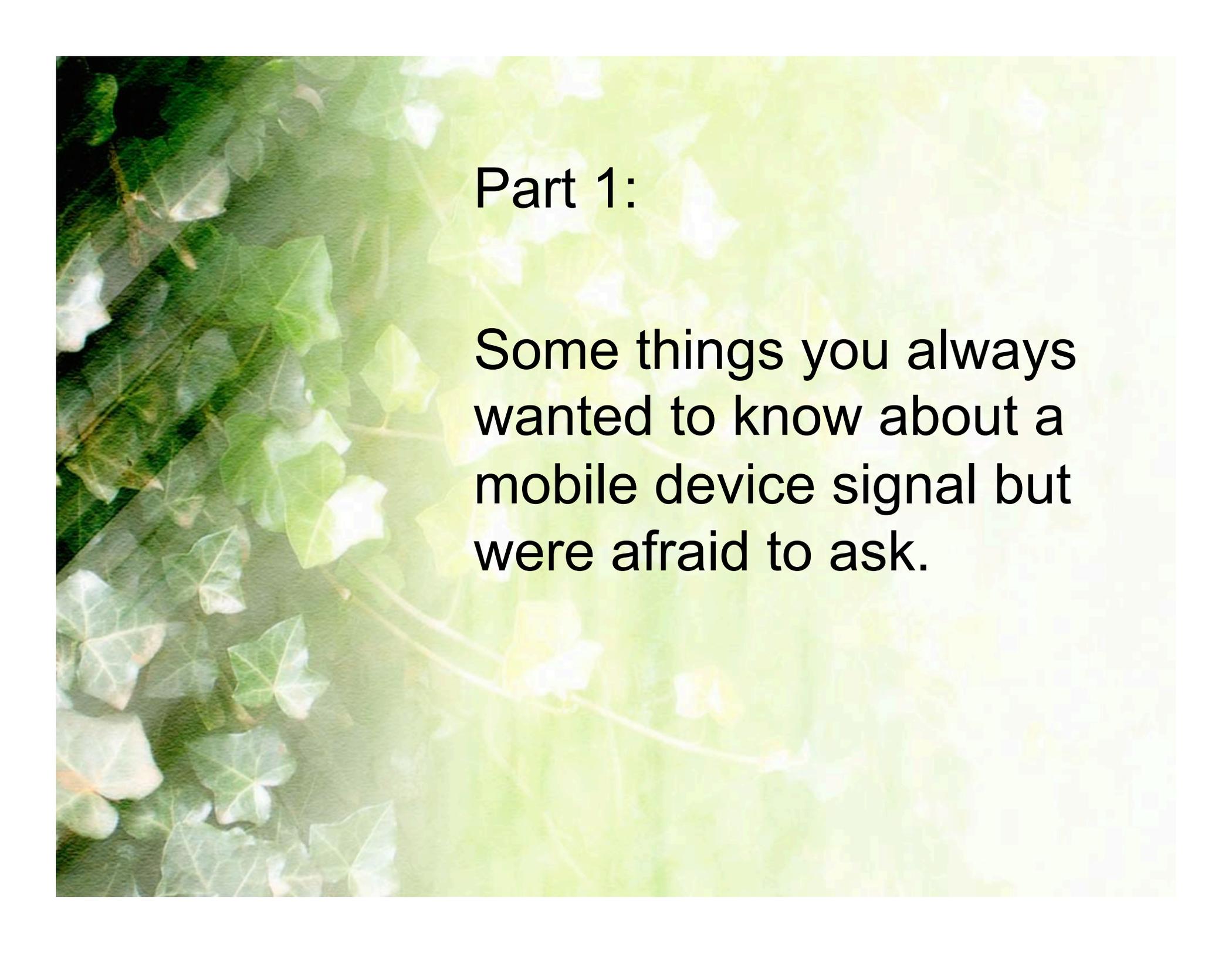
(NEHA 2012)

June 30, 2012



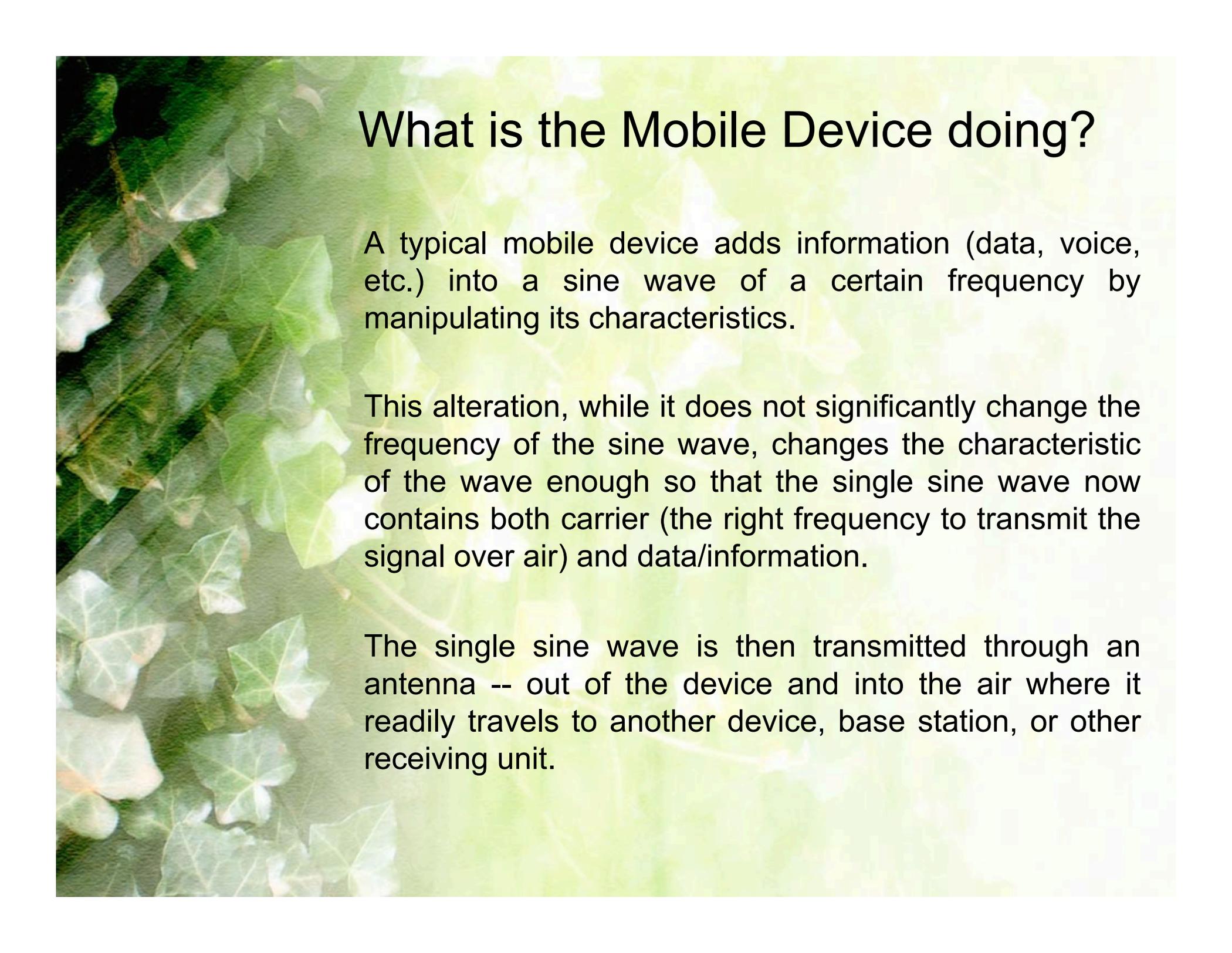
Outline

- Some things you always wanted to know about a mobile device signal but were afraid to ask.
- Some things you probably didn't think you wanted to know about electromagnetic (EM) radiation.
- Some details about health risks
- Some attempt at a bottom line

The background of the slide is a photograph of green leaves and branches, likely ivy, with a soft, out-of-focus effect. The leaves are various shades of green, from dark to light, and are scattered across the frame. The text is overlaid on the right side of the image.

Part 1:

Some things you always wanted to know about a mobile device signal but were afraid to ask.

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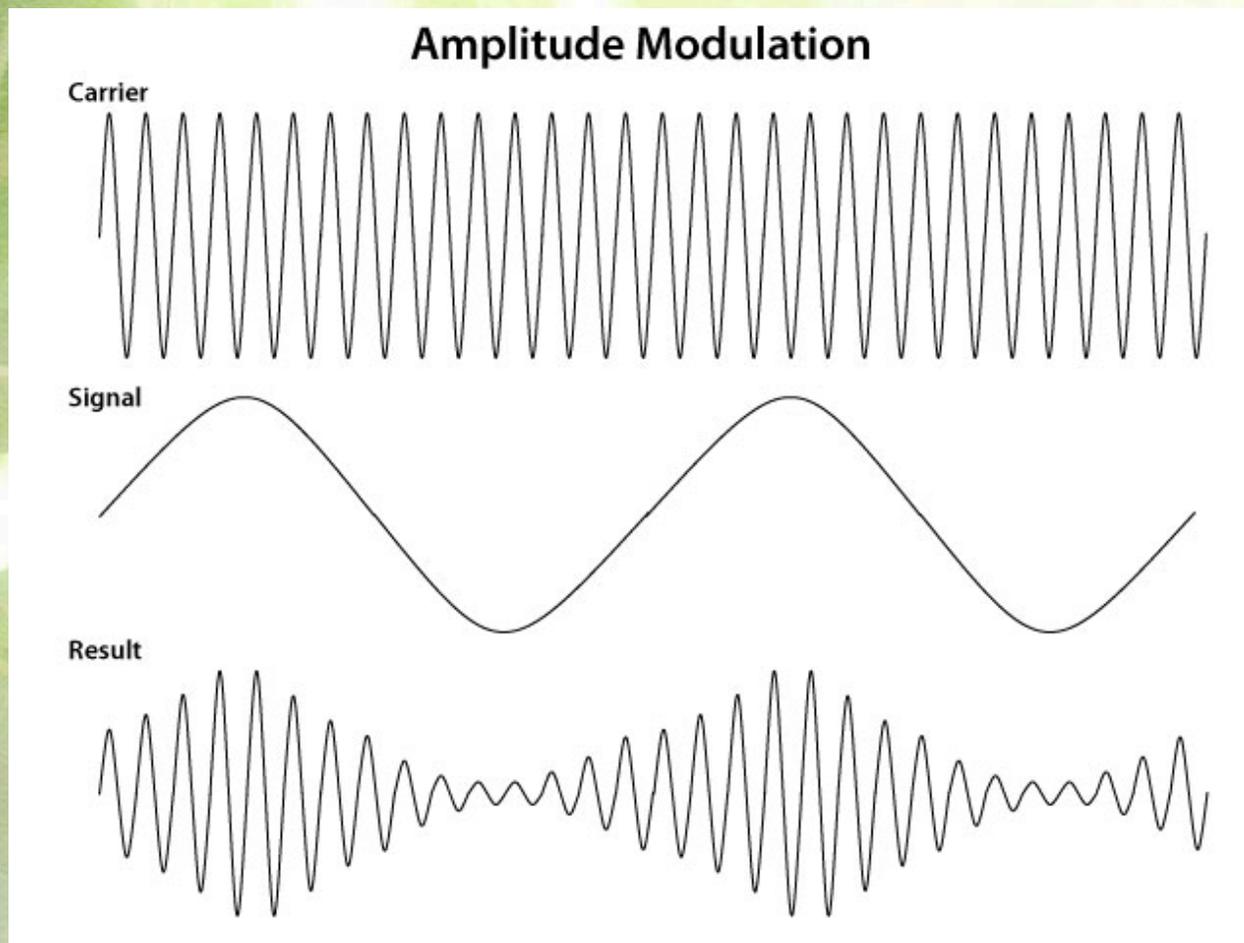
What is the Mobile Device doing?

A typical mobile device adds information (data, voice, etc.) into a sine wave of a certain frequency by manipulating its characteristics.

This alteration, while it does not significantly change the frequency of the sine wave, changes the characteristic of the wave enough so that the single sine wave now contains both carrier (the right frequency to transmit the signal over air) and data/information.

The single sine wave is then transmitted through an antenna -- out of the device and into the air where it readily travels to another device, base station, or other receiving unit.

What is the Mobile Device doing?



Source: The Esoteric Teaching: <http://www.oldsite.esotericteaching.org/>

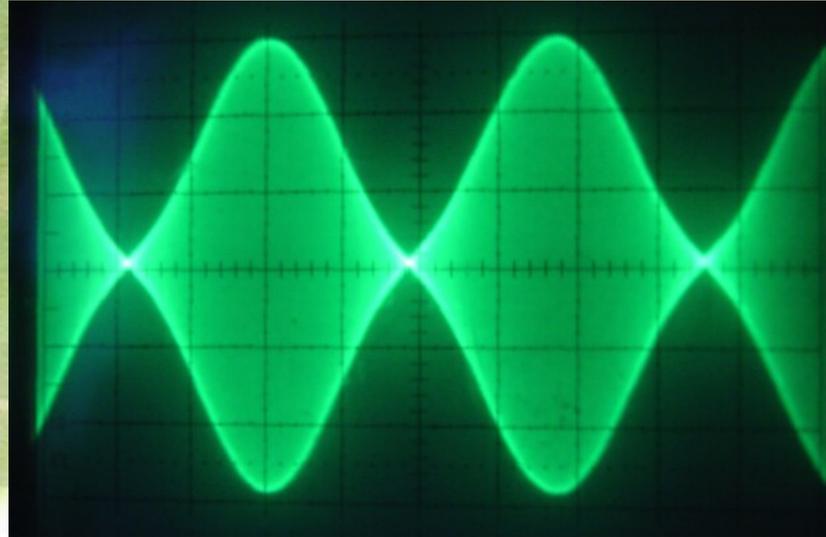
What is the Mobile Device emitting?

When the sine wave (carrier + information) gets converted from an electrical signal to a signal “in air”, it goes from being an electrical wave to an electromagnetic wave.



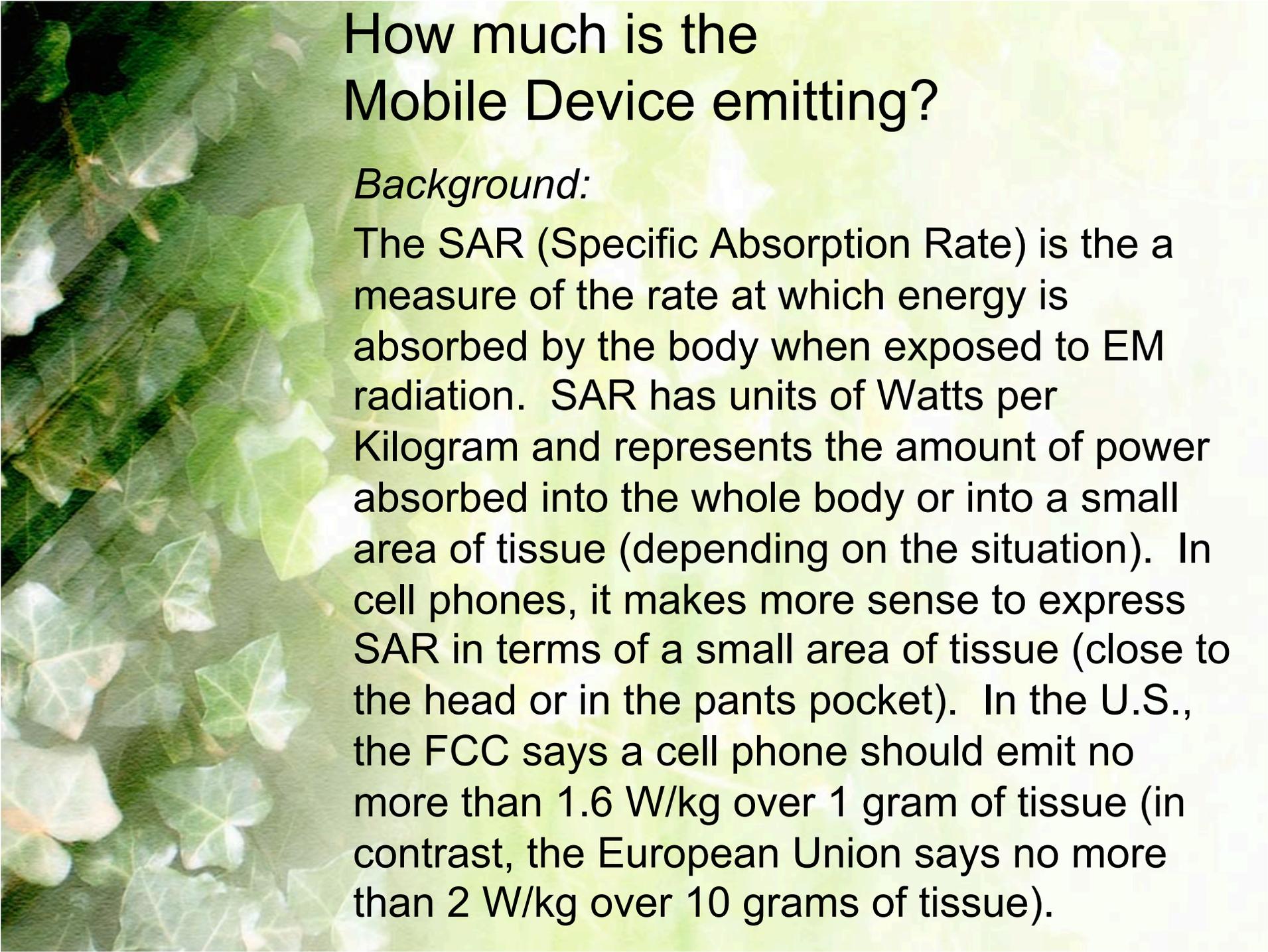
The electromagnetic waves are a form of radiation (called radio frequency electromagnetic radiation) that is non-ionizing. Ionizing radiation (x-rays, gamma rays, etc.) is inherently more dangerous than non-ionizing radiation because it is known to directly damage genes/DNA and to lead to uncontrolled reproduction in cells (= cancer). Radio frequency means the carrier (underlying frequency) of the electromagnetic wave is between 100kHz and 10 GHz.

How fast is the Mobile Device radiating?



Typical “carrier” frequencies of mobile devices:

- Cell phones (GSM900) in the U.S.
 - 890-915MHz output & 935-960MHz input
 - Some GSM1900
- WIFI: around 2.4GHz
- Cordless Phone:
 - Older: 1.7 MHz, 43-50 MHz
 - Newer: 900 MHz, 1.9 GHz, 2.4 GHz, 5.8 GHz

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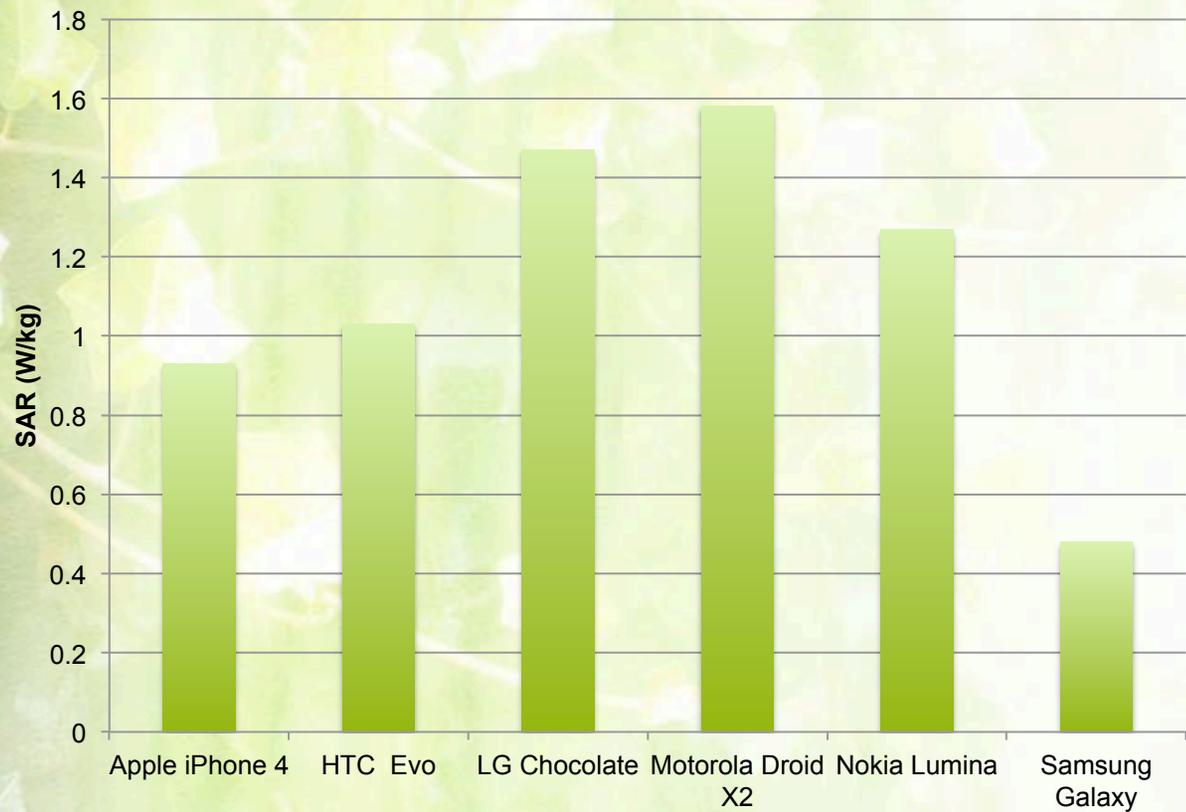
How much is the Mobile Device emitting?

Background:

The SAR (Specific Absorption Rate) is the a measure of the rate at which energy is absorbed by the body when exposed to EM radiation. SAR has units of Watts per Kilogram and represents the amount of power absorbed into the whole body or into a small area of tissue (depending on the situation). In cell phones, it makes more sense to express SAR in terms of a small area of tissue (close to the head or in the pants pocket). In the U.S., the FCC says a cell phone should emit no more than 1.6 W/kg over 1 gram of tissue (in contrast, the European Union says no more than 2 W/kg over 10 grams of tissue).

How much is the Mobile Device emitting?

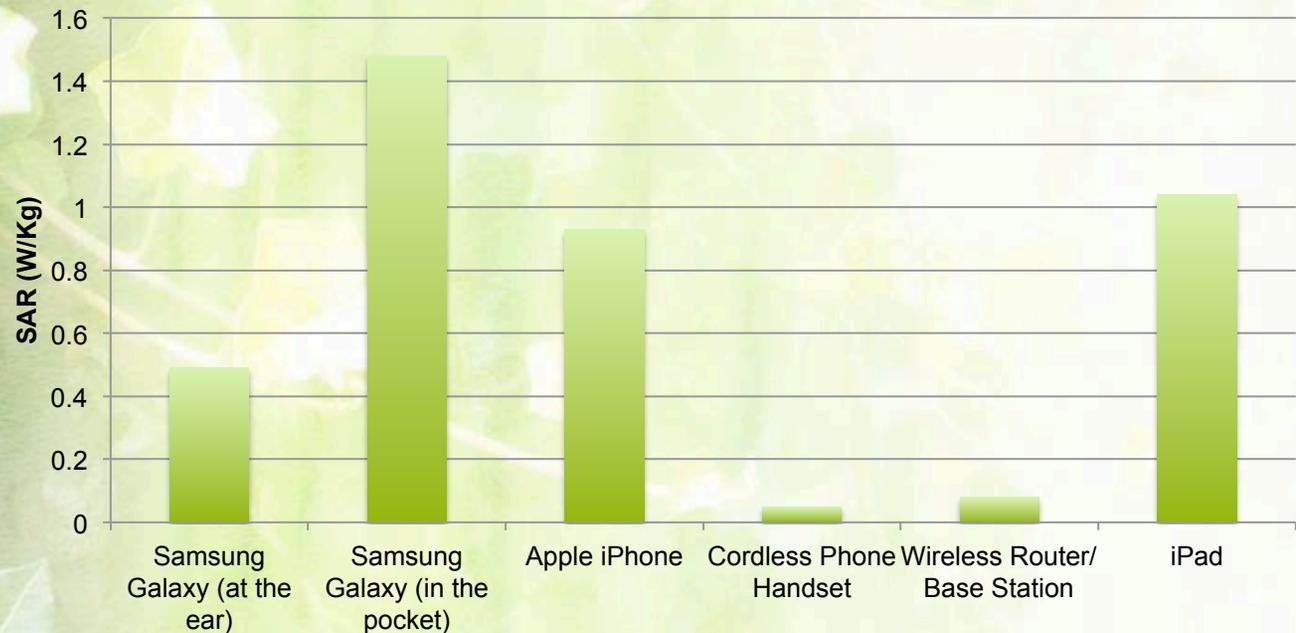
Cell Phones:

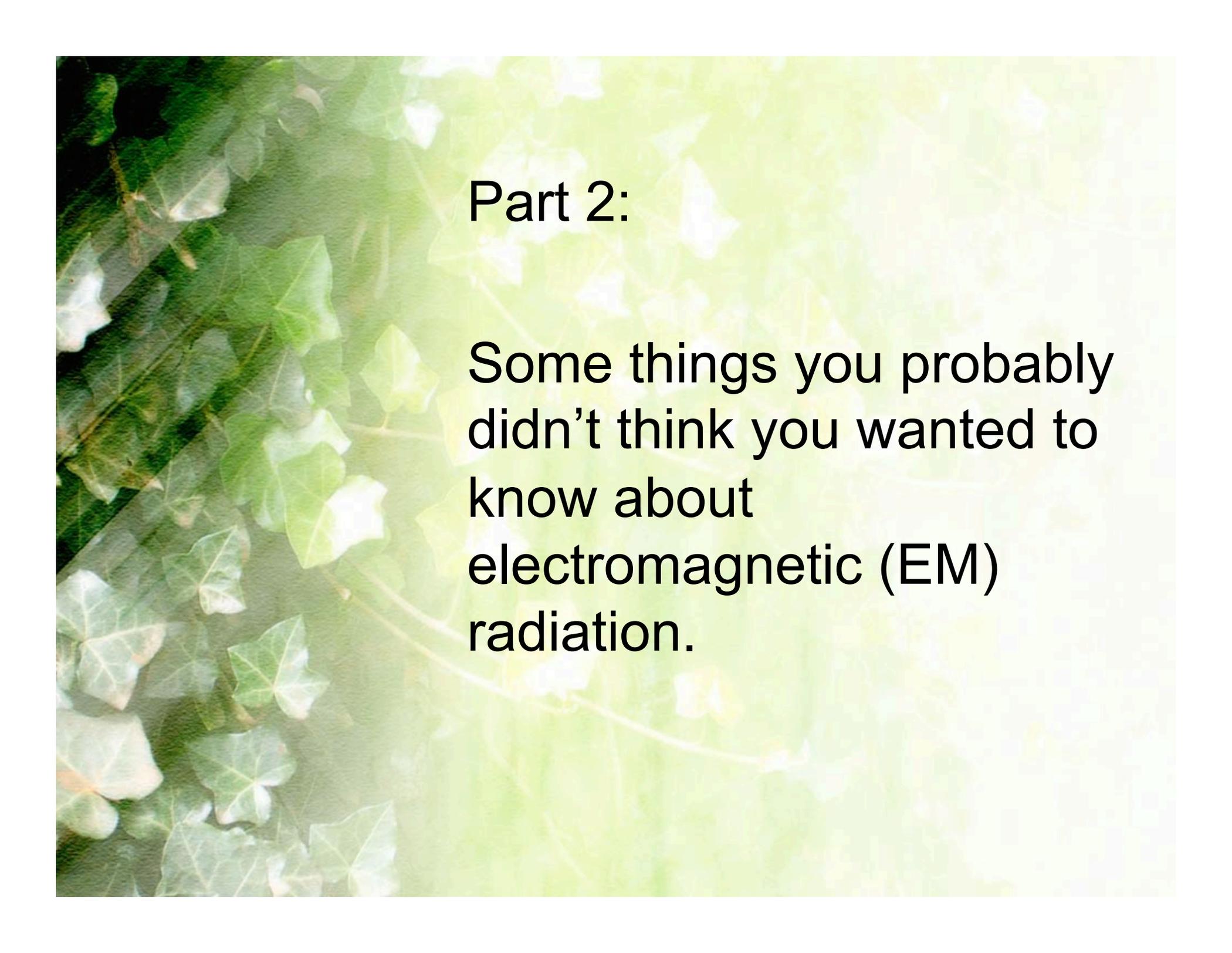


How much is the Mobile Device emitting?

Other Mobile Devices:

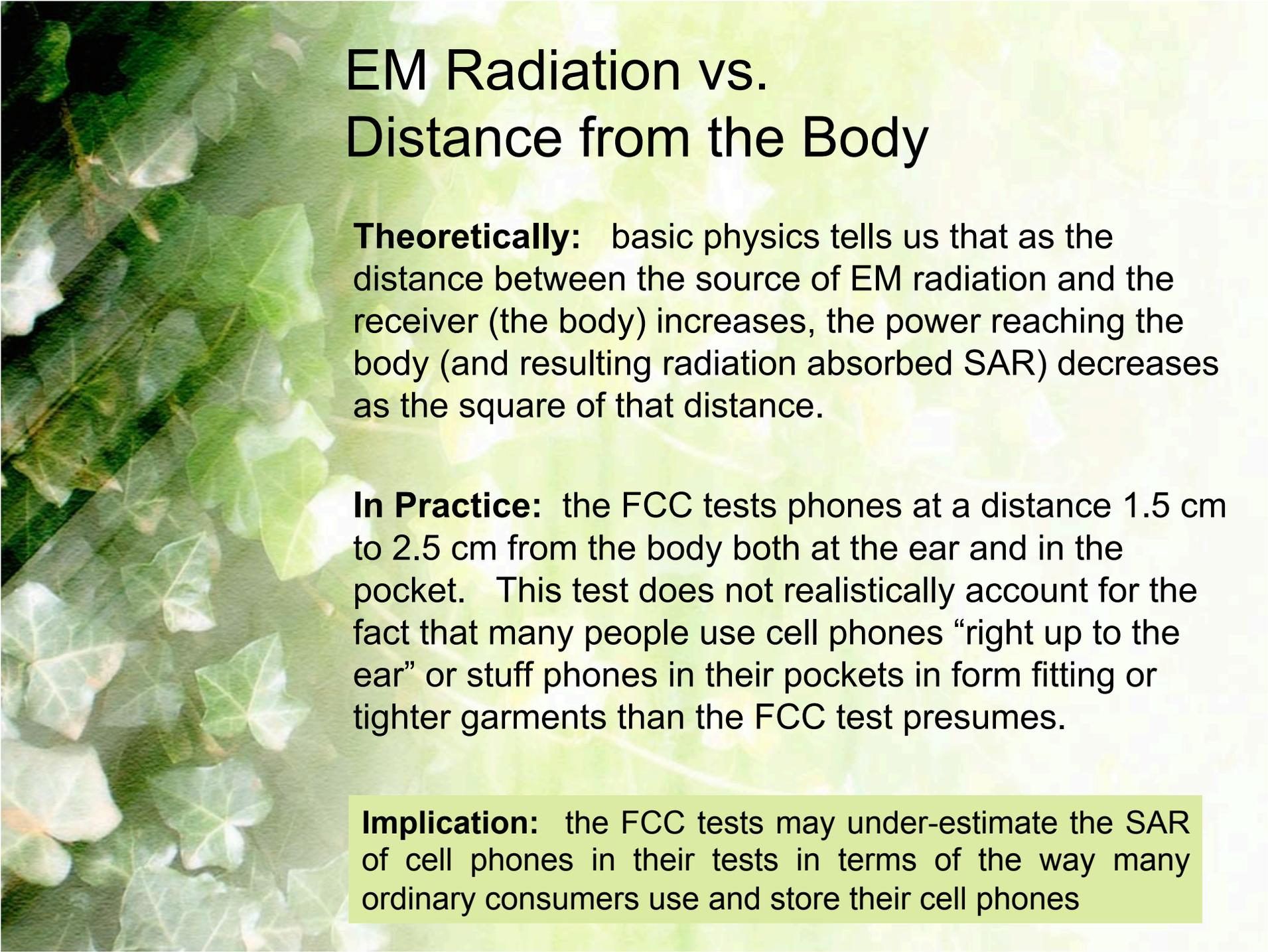
Laptop computers are a particular concern, not because they emit more radiation than base stations, but because they are often used in laps ... in direct contact with the body!





Part 2:

Some things you probably didn't think you wanted to know about electromagnetic (EM) radiation.



EM Radiation vs. Distance from the Body

Theoretically: basic physics tells us that as the distance between the source of EM radiation and the receiver (the body) increases, the power reaching the body (and resulting radiation absorbed SAR) decreases as the square of that distance.

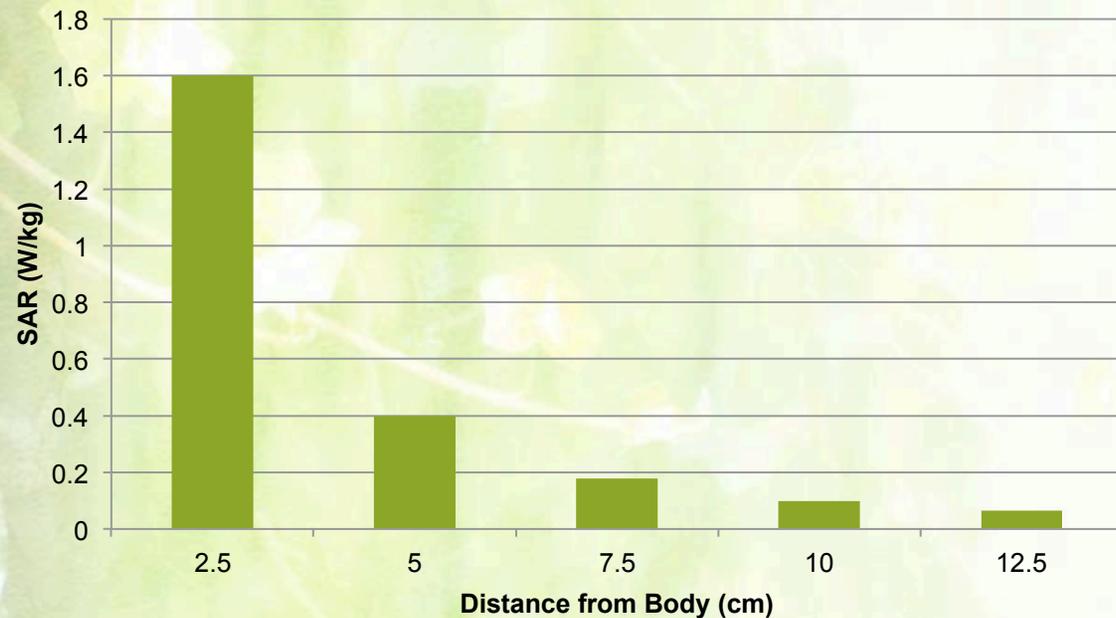
In Practice: the FCC tests phones at a distance 1.5 cm to 2.5 cm from the body both at the ear and in the pocket. This test does not realistically account for the fact that many people use cell phones “right up to the ear” or stuff phones in their pockets in form fitting or tighter garments than the FCC test presumes.

Implication: the FCC tests may under-estimate the SAR of cell phones in their tests in terms of the way many ordinary consumers use and store their cell phones

EM Radiation vs. Distance from the Body

Assuming the following conditions:

- A cell phone emits 1.6 SAR (maximum allowable level by FCC)
- At a distance 2.5 cm from the body (the upper limit of the FCC test)



EM Radiation vs. Signal Strength:

As the number of “bars” associated with a cell phone call decreases, the signal strength decreases, implying that the cell phone must use more power to transmit the call to the closest cell phone tower. The most common cause of low signal strength is a longer distance to a cell tower, but signal interference (humidity, metal or thick walls) can also reduce signal strength.

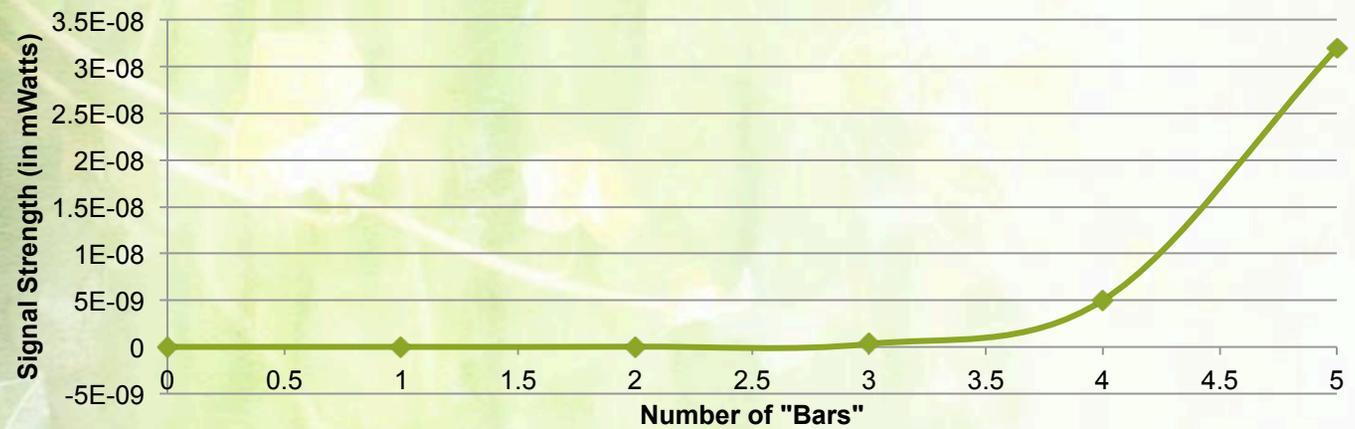
Approximate Signal Strength based on "Bars"

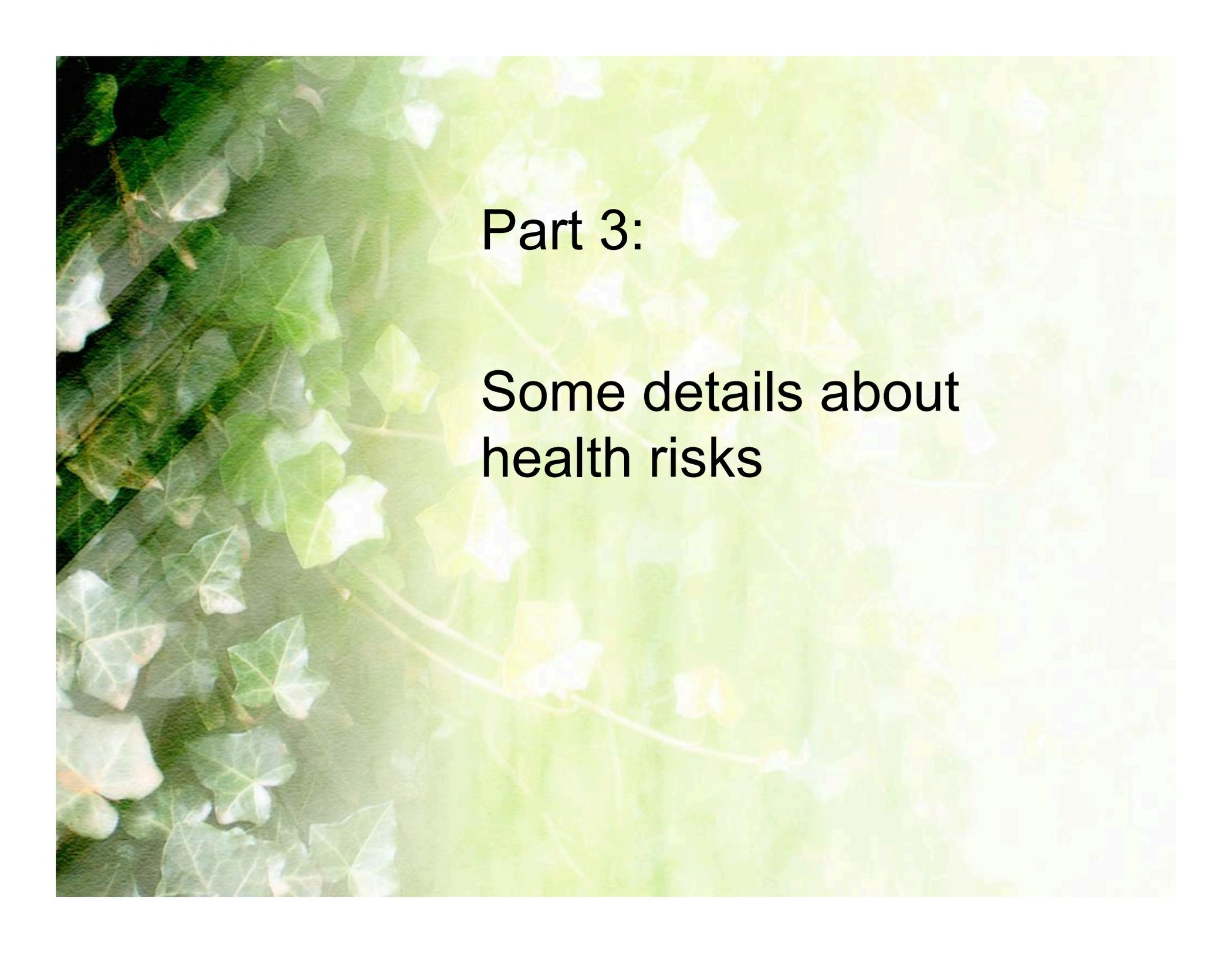


EM Radiation vs. Signal Strength:

Decibels can be easily converted to power. If we assume that the cell phone must directly compensate for loss of signal strength (e.g. a drop in signal strength by a factor of 10 means the phone must transmit 10x the power), then a phone call involving 1 “Bar” can emit up to 3000 times as much power as a phone call at 5 “Bars”

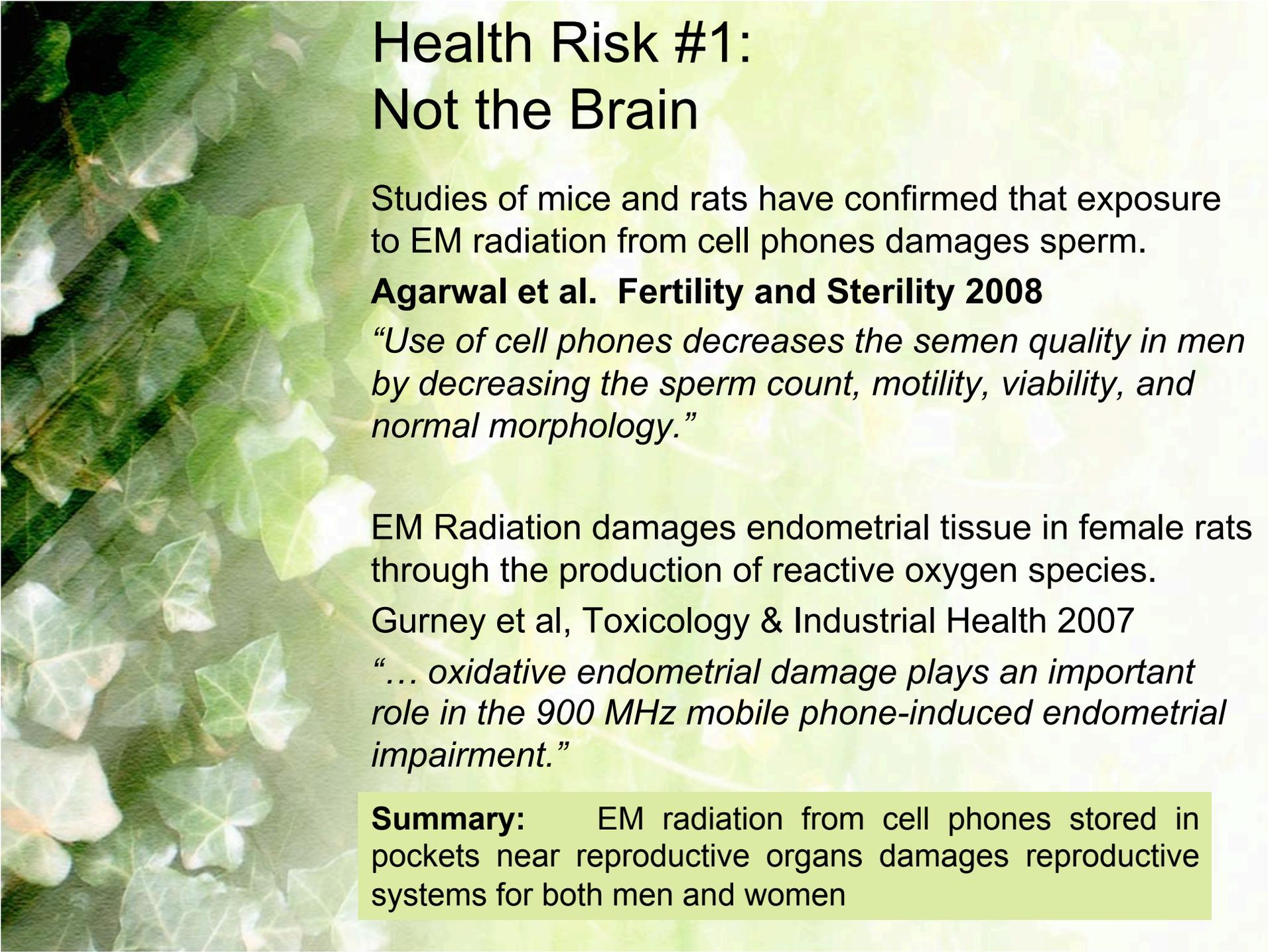
Approximate Signal Strength based on “Bars”



The background of the slide is a close-up photograph of green ivy leaves. The leaves are densely packed and have a characteristic three-lobed shape. The lighting is bright, creating a soft, slightly blurred effect in the background, while the foreground leaves are sharper. The overall color palette is various shades of green, from deep forest green to bright, almost white highlights where the leaves are catching the light.

Part 3:

**Some details about
health risks**



Health Risk #1: Not the Brain

Studies of mice and rats have confirmed that exposure to EM radiation from cell phones damages sperm.

Agarwal et al. Fertility and Sterility 2008

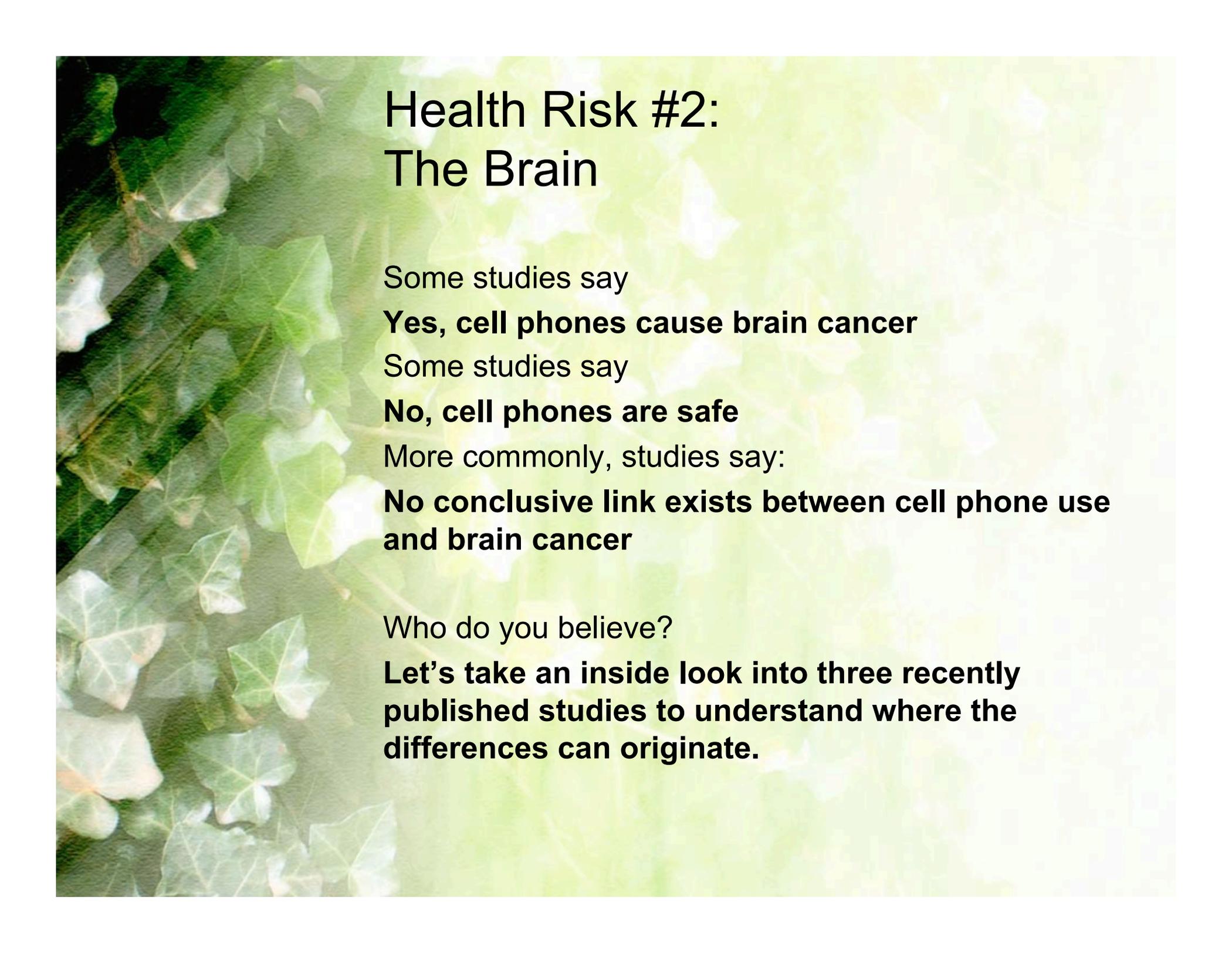
“Use of cell phones decreases the semen quality in men by decreasing the sperm count, motility, viability, and normal morphology.”

EM Radiation damages endometrial tissue in female rats through the production of reactive oxygen species.

Gurney et al, Toxicology & Industrial Health 2007

“... oxidative endometrial damage plays an important role in the 900 MHz mobile phone-induced endometrial impairment.”

Summary: EM radiation from cell phones stored in pockets near reproductive organs damages reproductive systems for both men and women

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Health Risk #2: The Brain

Some studies say

Yes, cell phones cause brain cancer

Some studies say

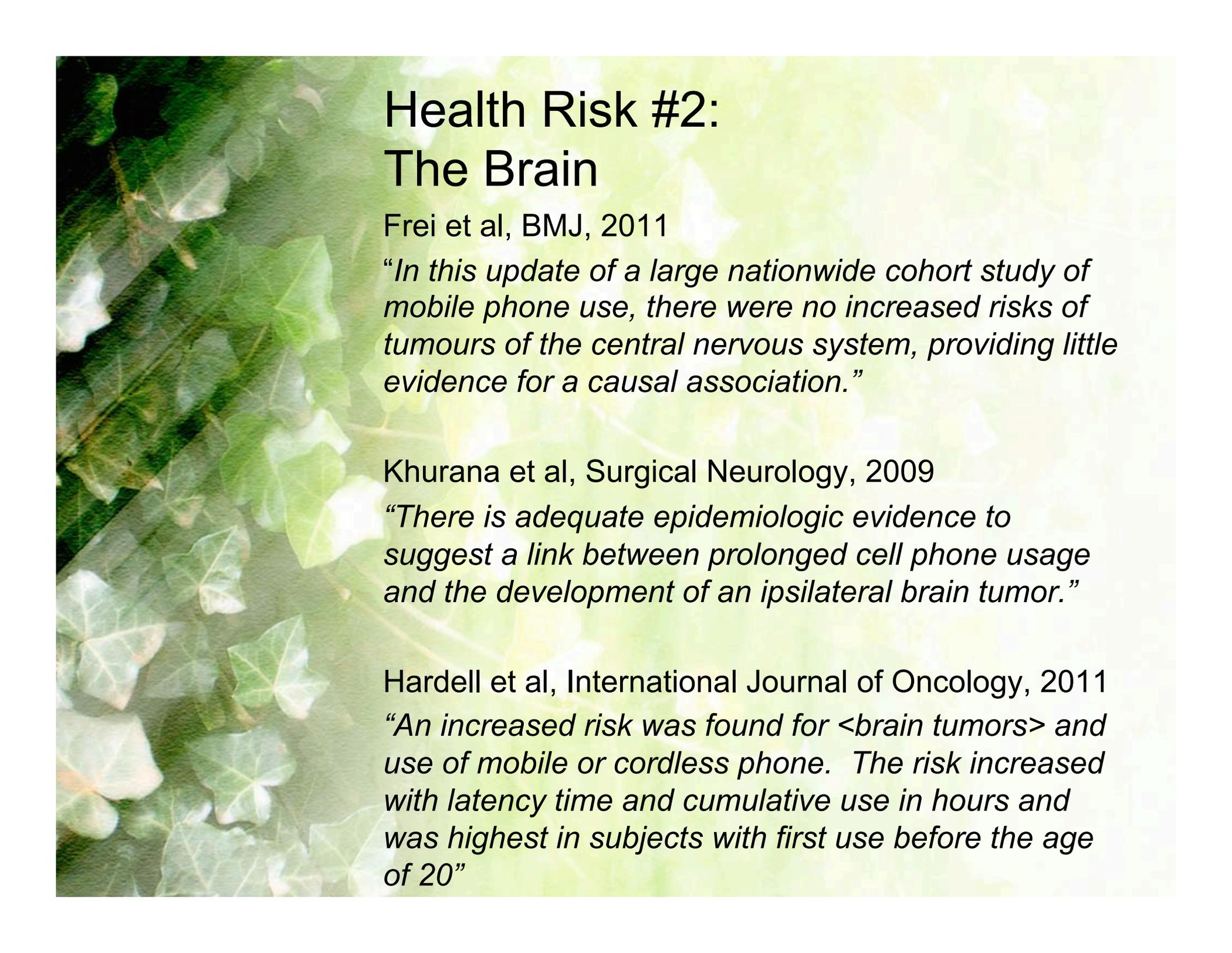
No, cell phones are safe

More commonly, studies say:

**No conclusive link exists between cell phone use
and brain cancer**

Who do you believe?

**Let's take an inside look into three recently
published studies to understand where the
differences can originate.**

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Health Risk #2: The Brain

Frei et al, BMJ, 2011

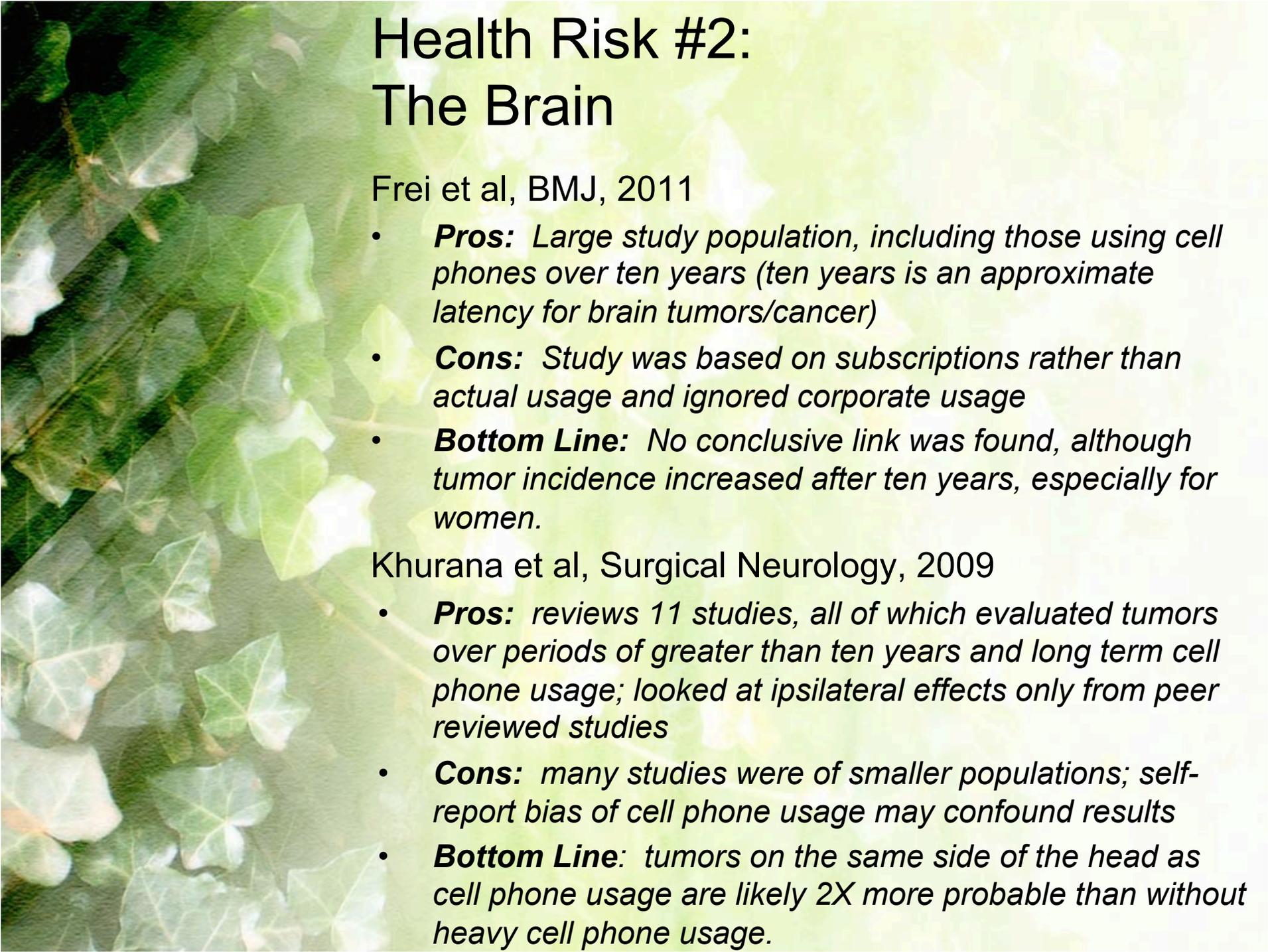
“In this update of a large nationwide cohort study of mobile phone use, there were no increased risks of tumours of the central nervous system, providing little evidence for a causal association.”

Khurana et al, Surgical Neurology, 2009

“There is adequate epidemiologic evidence to suggest a link between prolonged cell phone usage and the development of an ipsilateral brain tumor.”

Hardell et al, International Journal of Oncology, 2011

“An increased risk was found for <brain tumors> 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”



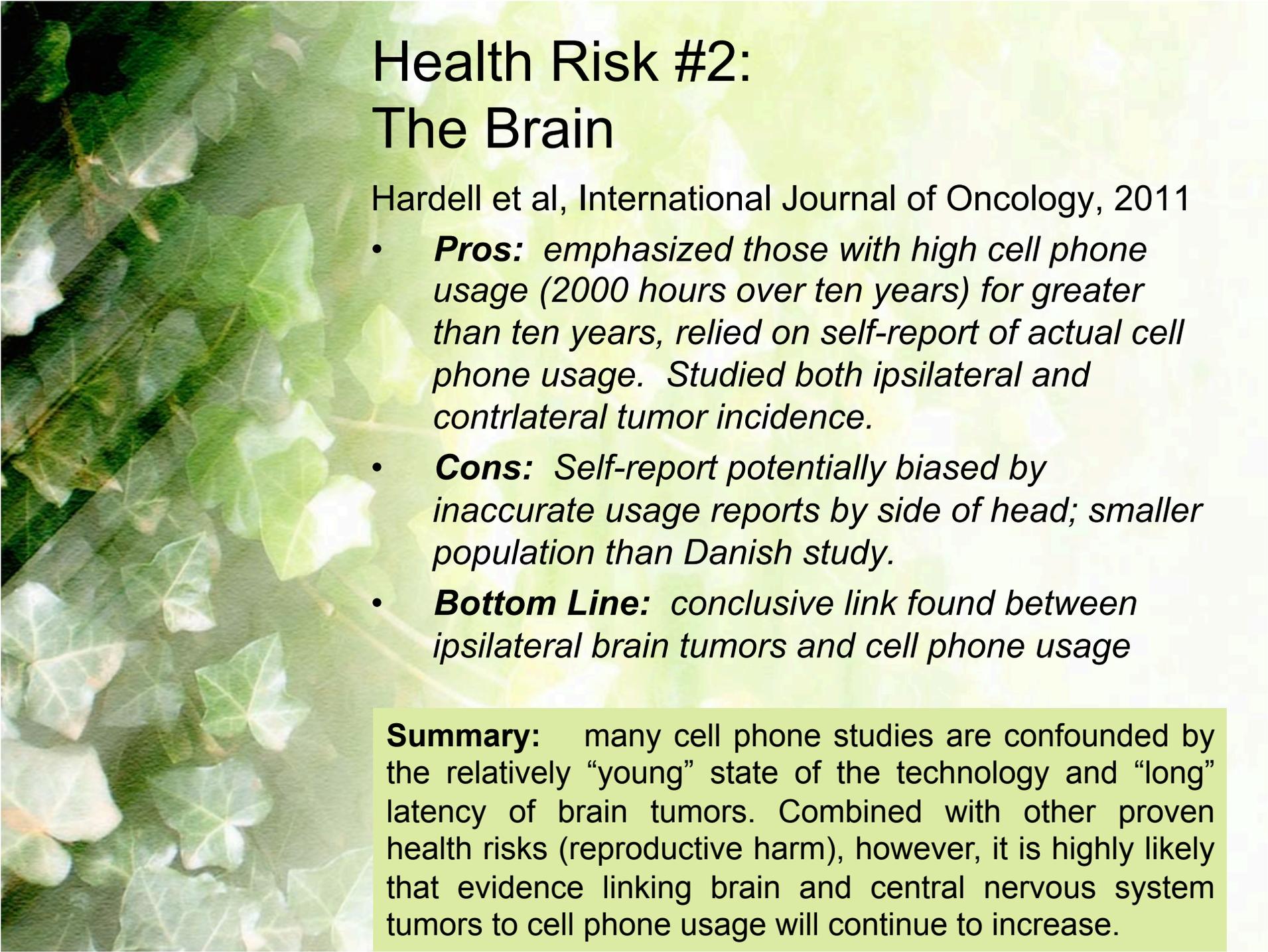
Health Risk #2: The Brain

Frei et al, BMJ, 2011

- **Pros:** *Large study population, including those using cell phones over ten years (ten years is an approximate latency for brain tumors/cancer)*
- **Cons:** *Study was based on subscriptions rather than actual usage and ignored corporate usage*
- **Bottom Line:** *No conclusive link was found, although tumor incidence increased after ten years, especially for women.*

Khurana et al, Surgical Neurology, 2009

- **Pros:** *reviews 11 studies, all of which evaluated tumors over periods of greater than ten years and long term cell phone usage; looked at ipsilateral effects only from peer reviewed studies*
- **Cons:** *many studies were of smaller populations; self-report bias of cell phone usage may confound results*
- **Bottom Line:** *tumors on the same side of the head as cell phone usage are likely 2X more probable than without heavy cell phone usage.*

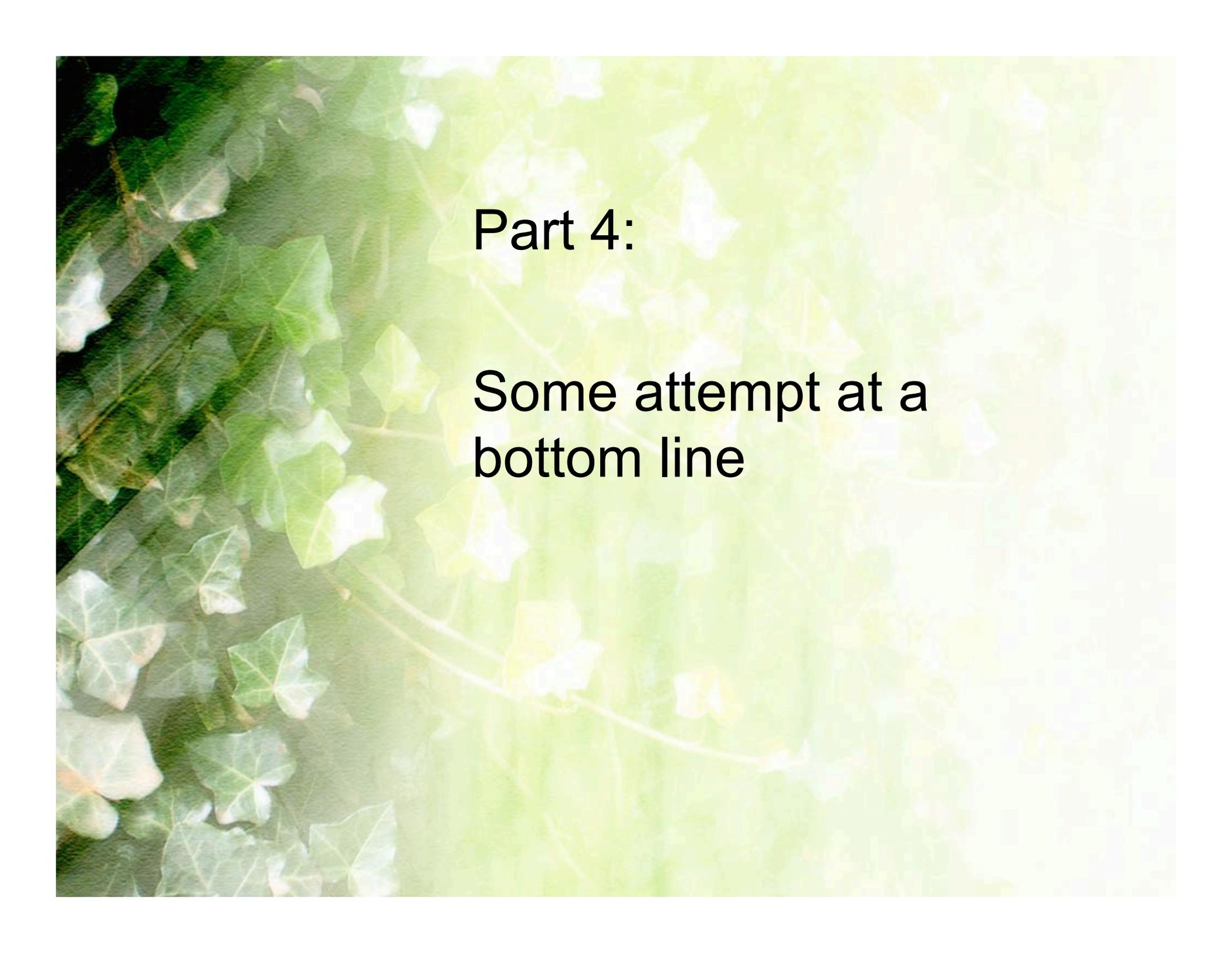


Health Risk #2: The Brain

Hardell et al, International Journal of Oncology, 2011

- **Pros:** *emphasized those with high cell phone usage (2000 hours over ten years) for greater than ten years, relied on self-report of actual cell phone usage. Studied both ipsilateral and contralateral tumor incidence.*
- **Cons:** *Self-report potentially biased by inaccurate usage reports by side of head; smaller population than Danish study.*
- **Bottom Line:** *conclusive link found between ipsilateral brain tumors and cell phone usage*

Summary: many cell phone studies are confounded by the relatively “young” state of the technology and “long” latency of brain tumors. Combined with other proven health risks (reproductive harm), however, it is highly likely that evidence linking brain and central nervous system tumors to cell phone usage will continue to increase.

The background of the slide is a close-up photograph of ivy leaves. The leaves are a mix of vibrant green and pale yellow-green, suggesting they might be in the process of changing color or are in a specific stage of growth. The lighting is soft, creating a gentle glow across the foliage. The text is overlaid on the right side of the image.

Part 4:

**Some attempt at a
bottom line**

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The Bottom Line

Cell Phone Usage can be harmful.

To Reproductive Capacity: YES

To the Brain: PROBABLY

Mobile Devices that communicate with each other wirelessly create a net (likely summative) EM radiation impact on the human body.

Top Five Ways to reduce absorption of EM radiation:

1. Make long phone calls over wired phones (either wired land-lines or wired headsets/speaker phone function on cell phones)
2. When not in use, store a cell phone at least several inches away from the body (pocket, head, etc.).
3. Text if you can. Talk by cell only if you must.
4. Avoid long periods close to any base station (wireless router, cell phone tower, etc...).
5. Avoid using devices in weak signal locations