

Smart Home



# *The Electromagnetic Age ... A Sleeping Giant?*



Malcolm Paterson, PhD



Informative Community Meeting  
 Oliver Community Centre  
 Oliver, BC  
 13 June 2015



Smart Grid





# **Malcolm Paterson BSc, MSc, PhD (Molecular Oncology)**

## **Disclaimer**

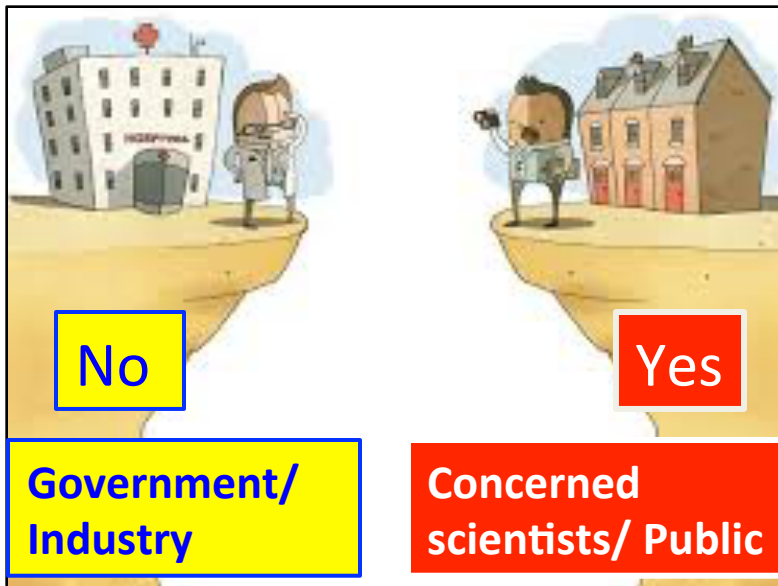
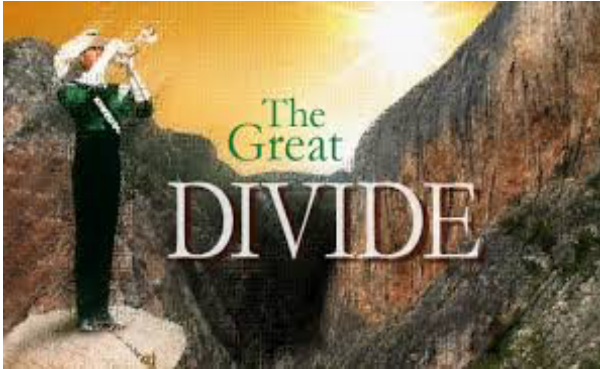
**No professional associations ('own dime, own time')**

**(Apr-Sep 2014: Scientific Advisor, BCCA Sindi Ahluwalia Hawkins  
Centre for Southern Interior, Kelowna, BC)**

**Retainer: 3 grandchildren**

# Key Scientific Question

## Potential Health Effects of Our Wireless Age?



“Do long term, low level emissions from cell phones, WiFi in schools, and smart meters cause health effects?”

Clearly, they cause many biological effects.

# Lecture Goals



**MINDS ARE LIKE PARACHUTES...  
THEY ONLY FUNCTION WHEN OPEN!**

James Dewar

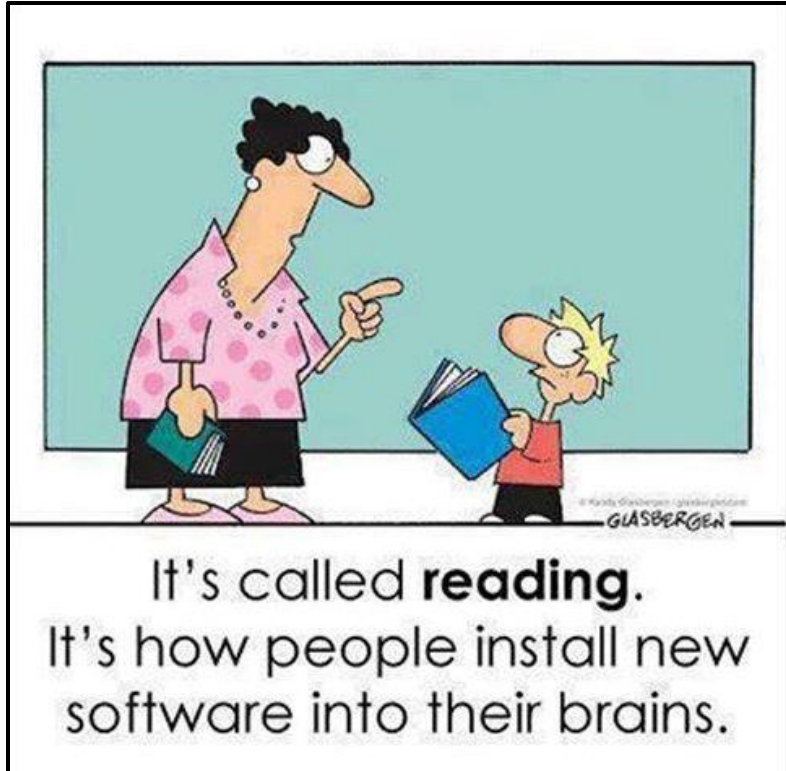
1. Review validated science on potential threat to human health from electromagnetic radiation (EMR) – unwanted byproduct of our high tech world.
2. Create informed citizenry empowered with accurate science-based evidence – *knowledge is power*.
3. Advocate urgent need for paradigm shift in decision-making (societal & personal) asking: **“How can we prevent harm?”** rather than **“What level of harm is acceptable?”**

# Outline

- **Introduction: Radiofrequency (RF) devices & electromagnetic fields (EMF)**
- **Primer on scientific methods**
- **Current standards & guidelines**
- **Dissenting views: Bio-effects & adverse health effects**
- **Sensitive populations**
- **Coffee Break**
- **Smart meter/grid technology**
- **Public health impact: Great divide**
- **Late lessons from early warnings**
- **Game changer: Precautionary principle in risk management**
- **Concluding remarks**

# Lecture Format

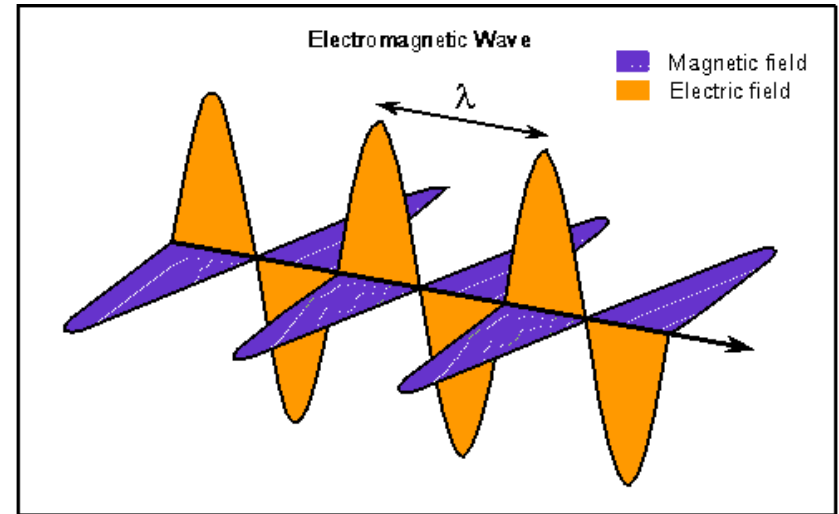
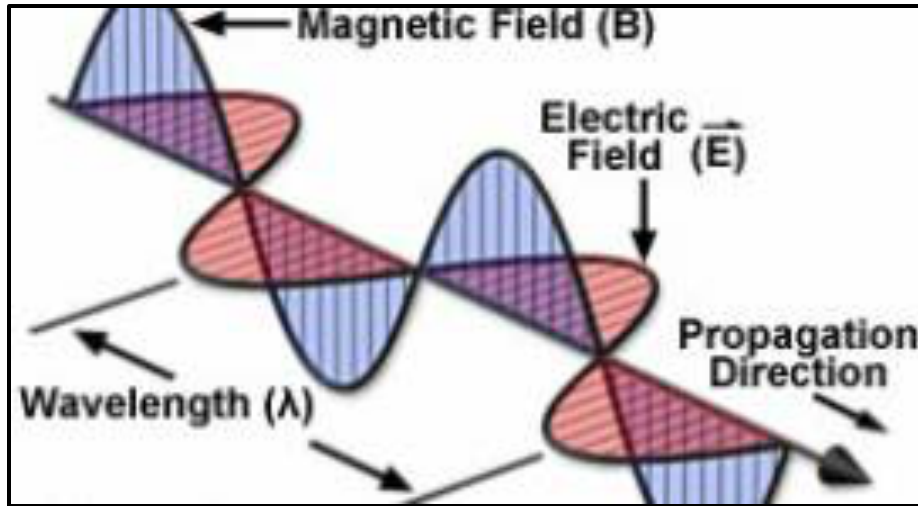
- Two parts: limit no. of slides (~35) and duration of each formal talk (45 min)
- Leave 30 min for Q & A



**“They don’t give us time to learn anything; we have to listen to the teacher all day.”**

**Introduction: Radiofrequency (RF)  
devices & electromagnetic fields (EMF)**

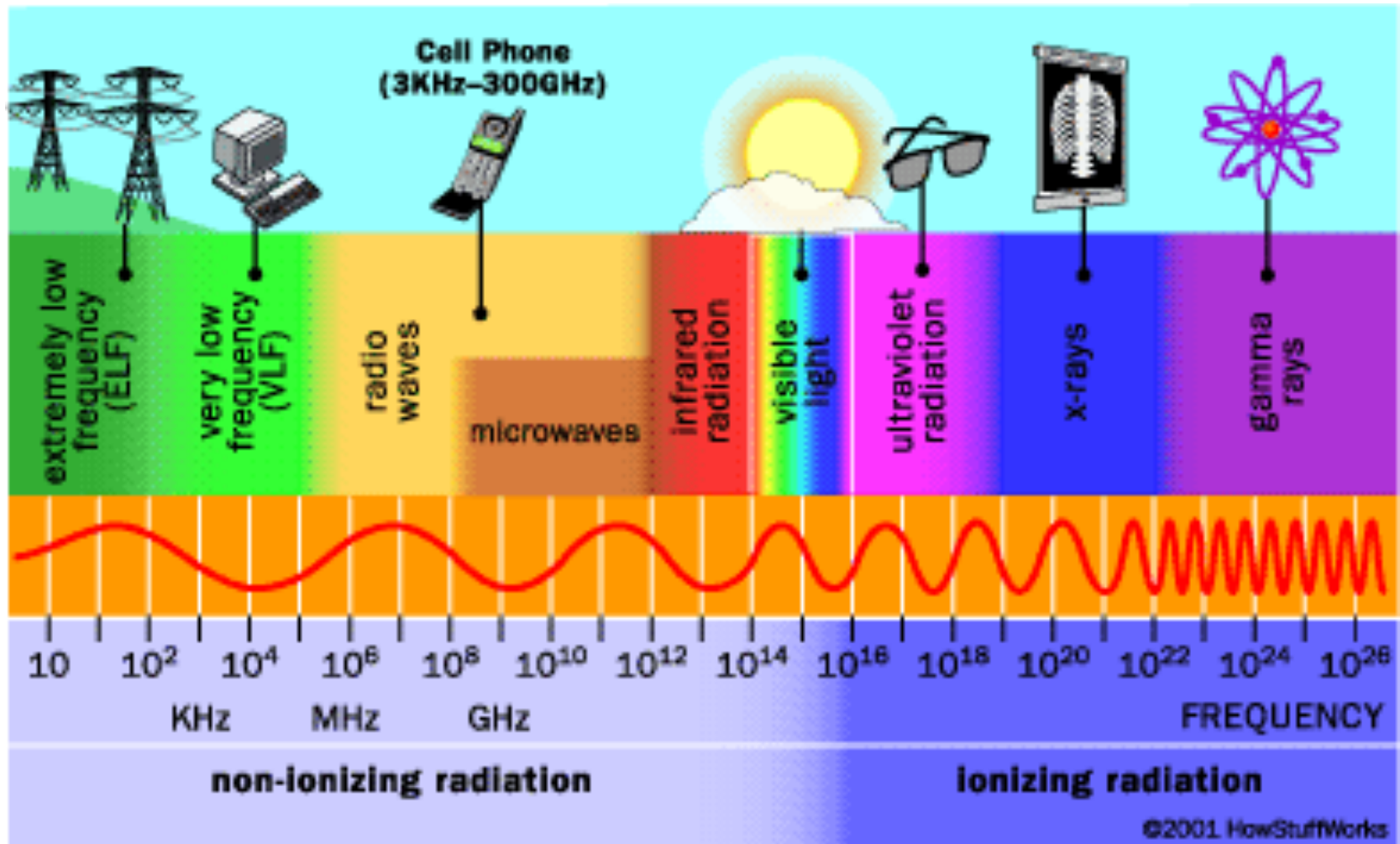
# Properties of Electromagnetic Radiation



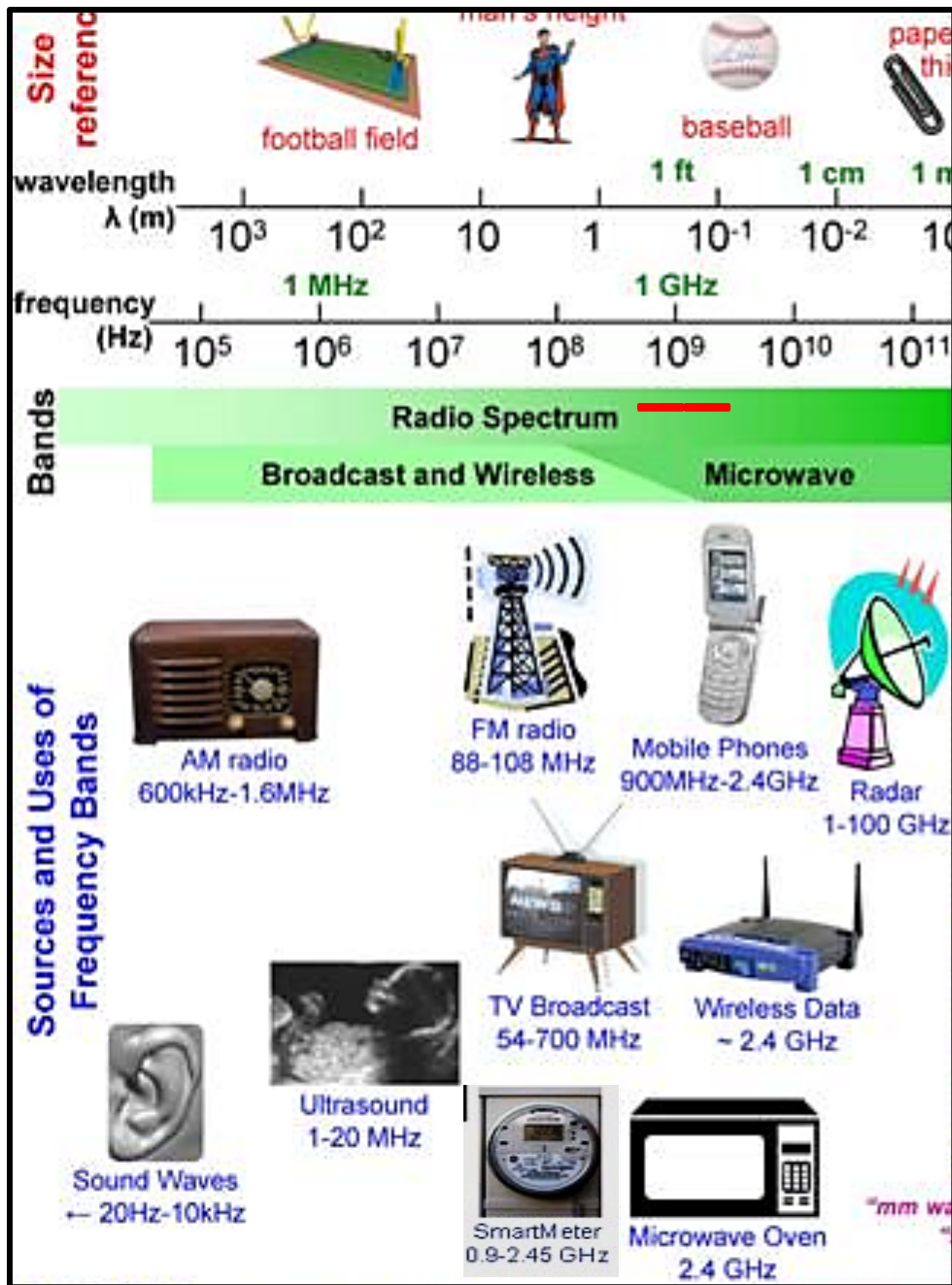
- Emits energy as self-sustaining & oscillating electric & magnetic fields
- Fields travel at right angles to each other and to direction of propagation
- Defined by frequency [# oscillations/sec, Hertz (Hz)] & wavelength (1/freq., m)
- Electric field (EF) arises from presence of electric charges; volts/m (V/m)
- Magnetic field (MF) due to motion of electric charges (alternating current); gauss (G) or tesla (T).



# Electromagnetic Radiation (EMR) Spectrum



- Higher frequency, shorter wavelength, higher energy
- Radiofrequency: 3kHz-300GHz (wireless devices/telecommunication systems)



# RF Spectrum

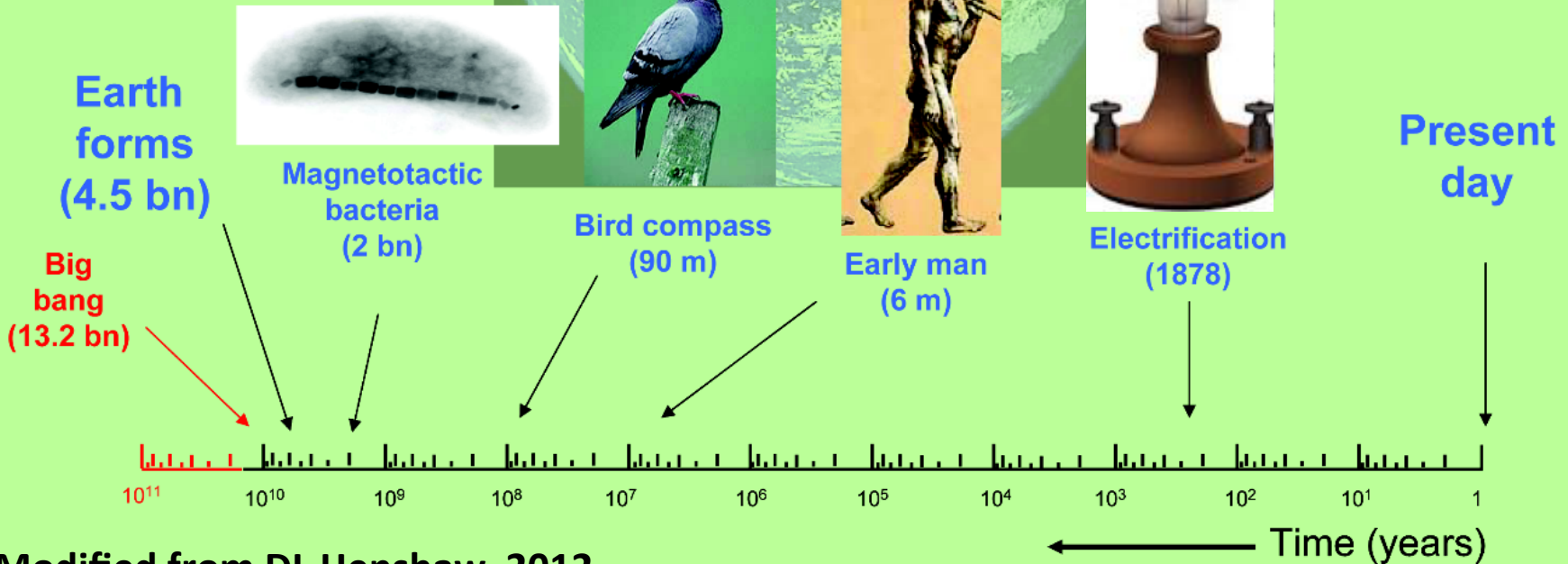
- Wireless phones, WiFi routers, microwave ovens & smart meters
- Freq. range: 800 MHz to 5.8 GHz

# Electrification: Recent Event

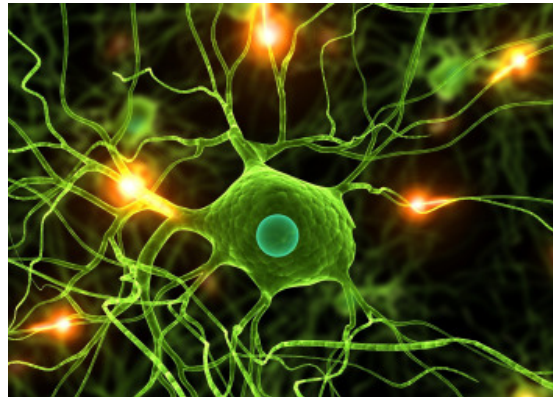
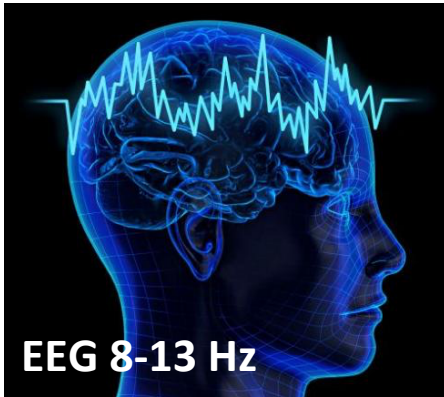
Magneto-reception in animal orientation & navigation: sensitive down to 0.1 mG



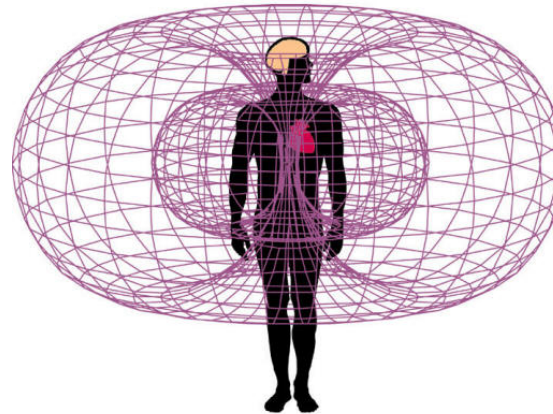
Geomagnetic field ~ 500 mG



# We're electromagnetic -- all wired up!



**Brain activity**  
(Optimal 7.83 Hz)

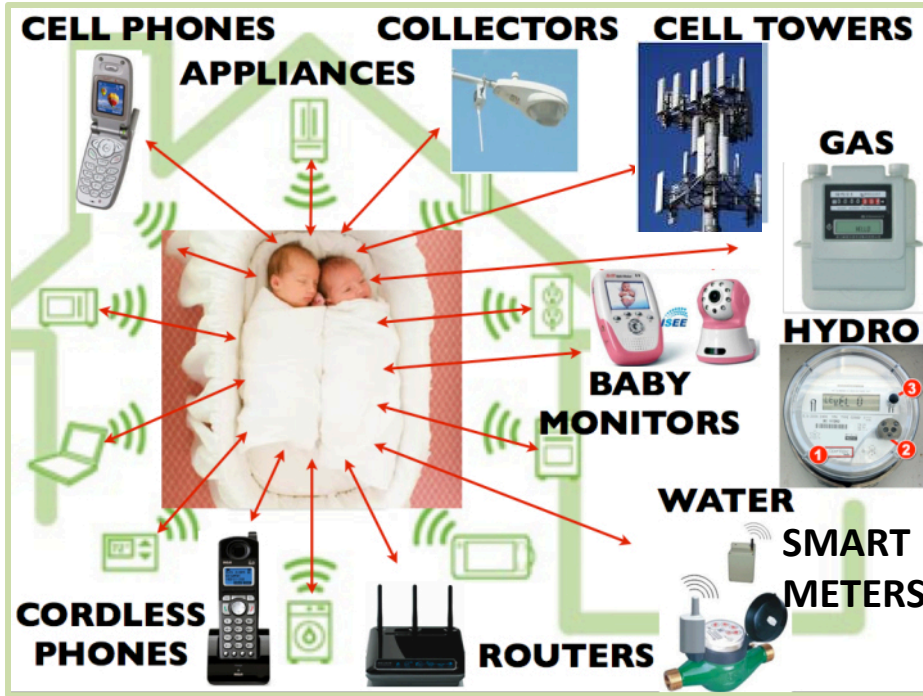


**Electromagnetic field of heart**



- Our brain, heart, muscles and pancreas all work on electricity.
- Same power as used by computer
- When awake, human brain produces enough electricity to power small light bulb.

# ...and We're Blanketed in 'Electro-Smog'



TV/RADIO TOWERS



POWER LINES



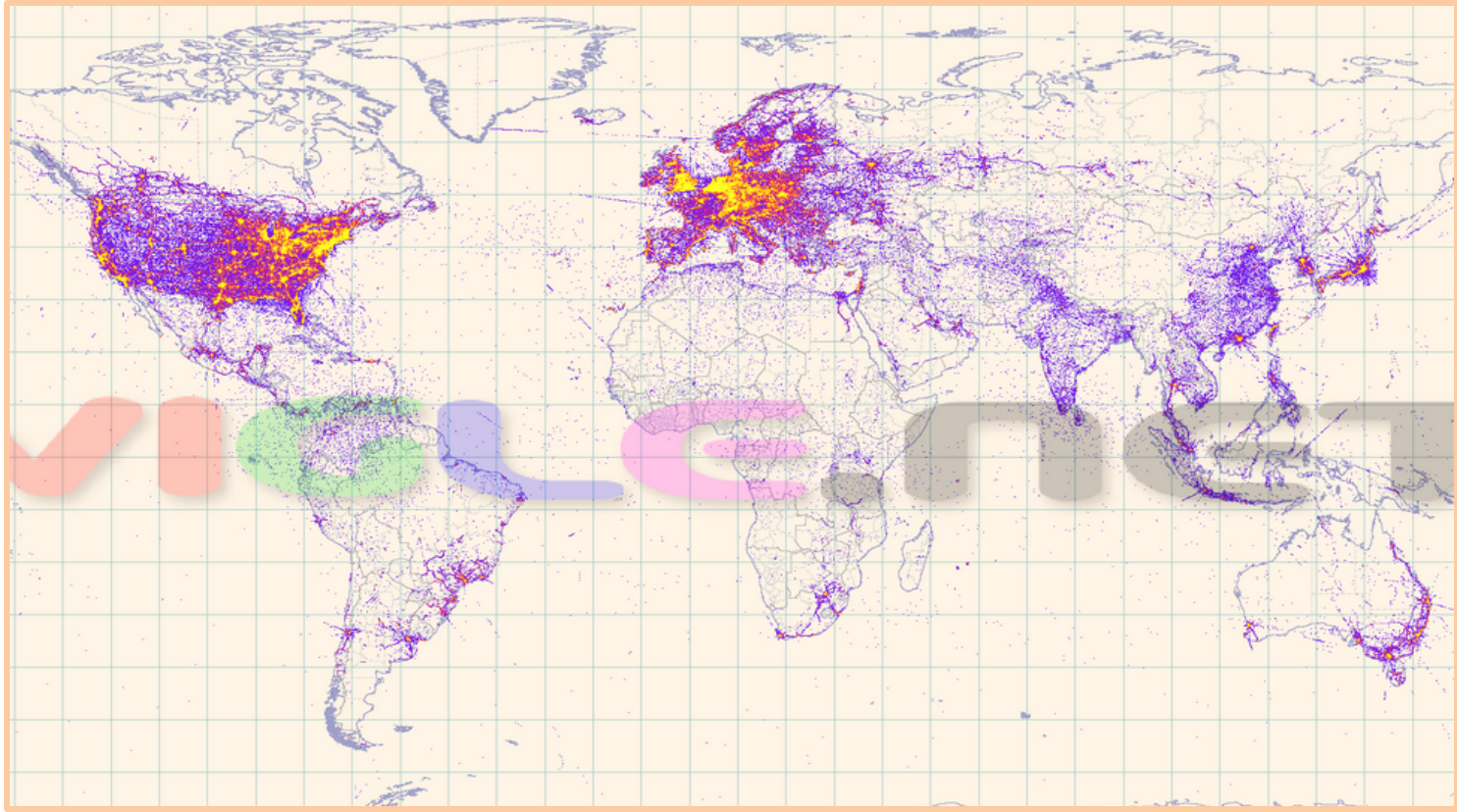
SMART MATTRESS COVER



- Massive roll-out of wireless devices has led to record RF energy levels in our daily lives.
- Exposures are extensive, rising rapidly, and inescapable; vastly upping the stakes, both health and economic.
- Mobile technology usage estimated to increase 7-fold in next 5 yrs

B. Lord, CEO CWTA

# Global Wireless Map 2014

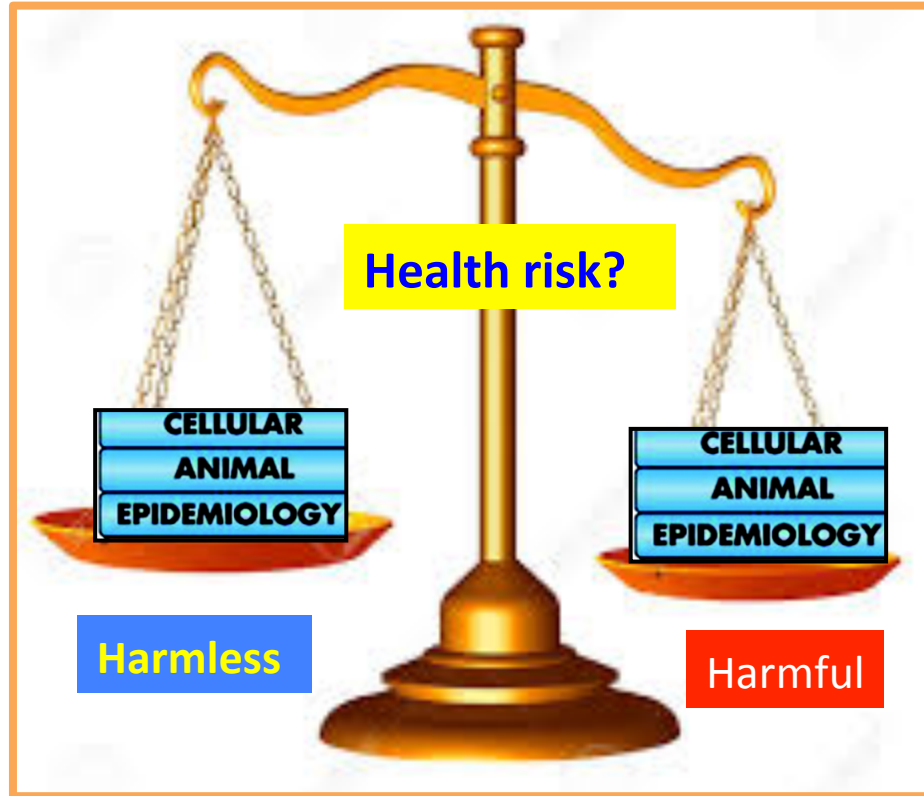


Source: [www.wigle.net](http://www.wigle.net)

- Current RF radiation levels in cities can be  $\sim 3 \mu\text{W}/\text{cm}^2$  and increasing rapidly
- 3 of every 4 persons today live in mega-cities (>10 million); many in developing countries where levels poorly controlled
- Increased 3000 times from 1980 background levels ( $0.001 \mu\text{W}/\text{cm}^2$ ).

# **Primer on Scientific Methods**

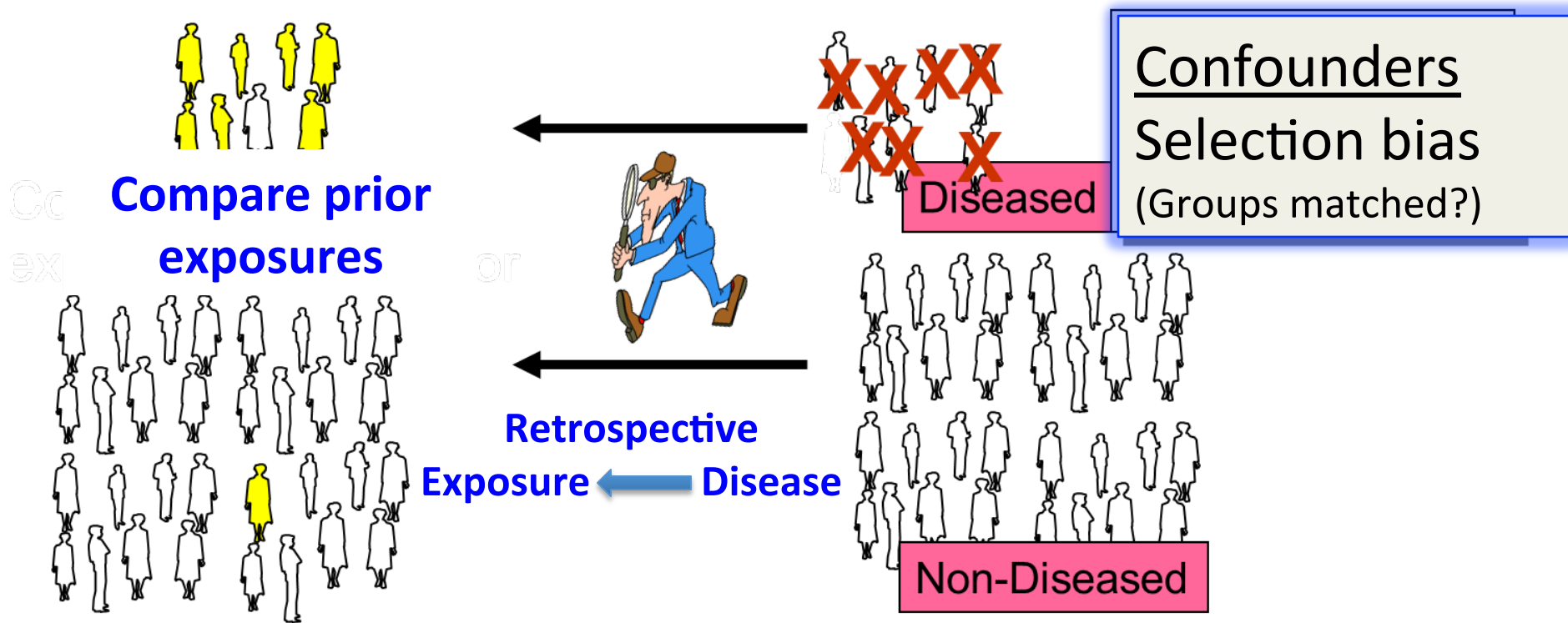
# 'Weight-of-Evidence' Review



- Evaluate **all relevant** studies in peer-reviewed scientific literature
- Three types of research considered:
  1. human epidemiology studies (disease distribution, causal factor linkage)
  2. experimental studies in animals (*in vivo* research)
  3. experimental studies in cells & tissues (*in vitro*, mechanistic studies)



# Design of Case-Control Study



**Critically dependent on: study design, observational astuteness of investigators**

*'You can observe a lot by watching.'* Yogi Berra

Source: Boston University School of Public Health

# Current standards & guidelines†

†Many national agencies, including Health Canada, rely heavily on international limits recommended by WHO review panels.





# Exposure to RF Energy

## Specific Absorption Rate (SAR):

- rate at which body absorbs energy from RF radiation
- measured in watts per kilogram of tissue (W/kg)
- for whole body exposure, max. level is 0.08 W/kg averaged over 6 min<sup>£</sup>

## Power density:

- amount of energy in EM field in free space
- measured in  $\mu\text{W}/\text{cm}^2$
- max. permissible exposure ranges from 200  $\mu\text{W}/\text{cm}^2$  for 30-300 MHz to ~500 to ~900  $\mu\text{W}/\text{cm}^2$  for 2.2-5.2 GHz<sup>£</sup>
- describes strength of radiation itself, not energy absorbed from radiation

<sup>£</sup> Health Canada Safety Code 6

# Health Canada Safety Code 6 (2015)€

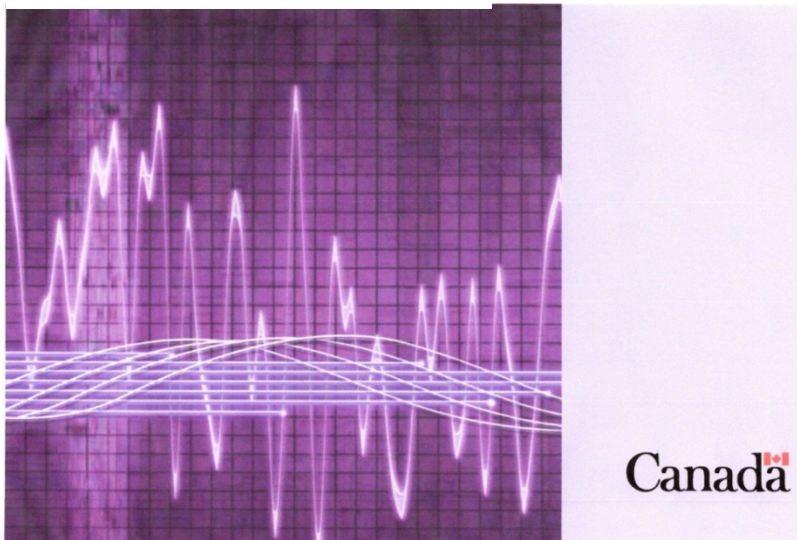


Health  
Canada Santé  
Canada

Your health and  
safety... our priority.

Votre santé et votre  
sécurité... notre priorité.

## Environmental and Workplace Health Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz Safety Code 6 (2015)



- **Purpose:** “establish **safety limits** for human exposure to **RF fields** in the frequency range from **3 kHz to 300 GHz.**”
  - “Despite numerous research studies on RF fields and health, **only established adverse effects ... relate to ... tissue heating and nerve stimulation (NS)... from short-term (acute) exposures.**”
  - “... freq. from **3 kHz to 10 MHz, NS from induced electric fields** within the body **must be avoided.**”
  - “For **freq. from 100 kHz to 300 GHz, tissue heating can occur and must be limited.**”
- € **Code applies to ...federally regulated sites.... may also be adopted by the provinces, industry ....**

**Safety limits consider only tissue heating effects.**

**Dissenting views:  
Bio-effects† & adverse health effects**

**†Physiological, biochemical and molecular changes**

# **Diverse Range of Bio-effects & Adverse Health Effects from RF EMF**

- **Adult brain tumors (glioma, acoustic neuroma) Alzheimer's disease, sleep disturbances, cognitive disorders (decreased memory), impaired learning and behaviour in children, autism**
- **Leakage of protective blood-brain barrier**
- **Male infertility: impaired sperm quality, mobility & viability**
- **Immunity dysfunction (allergic & inflammatory responses)**
- **Electro-hypersensitivity (EHS): debilitating multi-system condition leading to lost productivity; recognized in Sweden, Germany, Denmark, Austria, USA**
- **Genotoxic effects: DNA strand breaks, reduced DNA repair, induction of stress-response proteins**
- **Neurotoxic effects: death of neurons, pulsed RF-EMF affects brain function**
- **Pulsed EMF has wide therapeutic application: bone and wound healing.**

# Wireless (Cell & Cordless) Phones: Some Facts



- Meteoric growth in usage in last 15 yrs
- Globally, ~ 7 billion subscriptions
- Analog, single band (450 or 900 MHz)



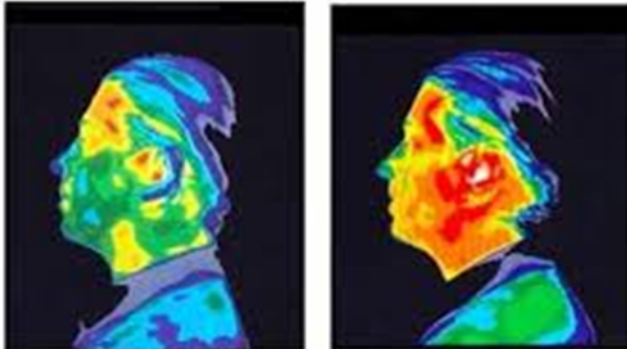
- Digital system (GSM), dual band (900/1800 MHz) , introduced in 1991
- 3G (1900/2100 MHz) dominant globally



- 4G (Terrestrial 3G) using 800/2600 MHz; established in Europe in 2009
- Cordless (1900 MHz) DECT; since 1990s

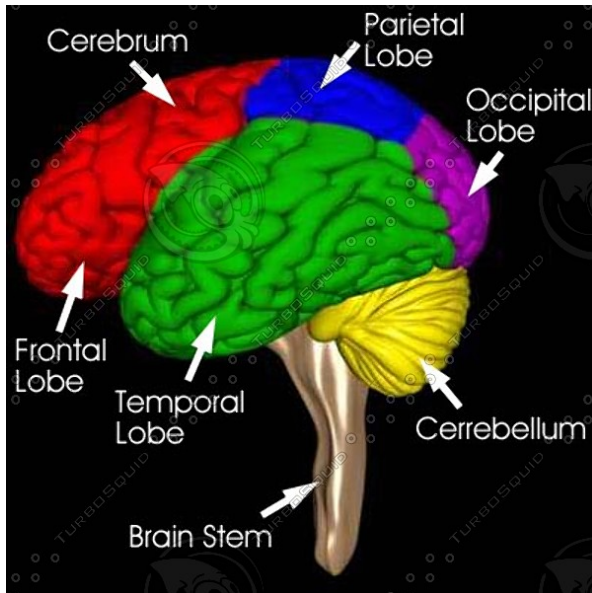
⌘ Automatic Power Control

# Wireless Phones & Brain Tumors



Thermographic image  
no phone      15-min call

- Four case-control studies: Sweden (Hardell); Europe (Interphone; 25 centres in 13 countries); Korea; France (CERENAT)
- Increased risk for glioma (~2-4 times), acoustic neuroma, meningioma
- Higher risk with: higher cumulative hrs of use (>2000 hrs); longer the time since first use (>10 yrs); most exposed area (same-side temporal, frontal lobes)
- Same-side phone use: 30 min/day for 10 yrs or more increases risk 3.7 times
- Alarming result, typical latency period: 15-25 yrs
- In 2011, these findings swiftly led IARC to classify **RF-EMF** as **Group 2B 'possibly carcinogenic'**.





# International Agency for Research on Cancer



World Health  
Organization

PRESS RELEASE  
N° 208

31 May 2011

## IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer<sup>1</sup>, associated with wireless phone use.

**This classification applies to all RF-emitting devices, including WiFi.**

- Robert A. Baan, PhD, IARC

**This classification justifies the implementation of the Precautionary Principle.**

- Dr. Darius Leszczynski, IARC

# Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (Review)

LL Morgan<sup>1</sup>, AB Miller<sup>2</sup>, A Sasco<sup>3</sup> and DL Davis<sup>1</sup>

Int. J. Oncol. 46: 1865, 2015

Key review article



Glioblastoma multiform  
CT scan

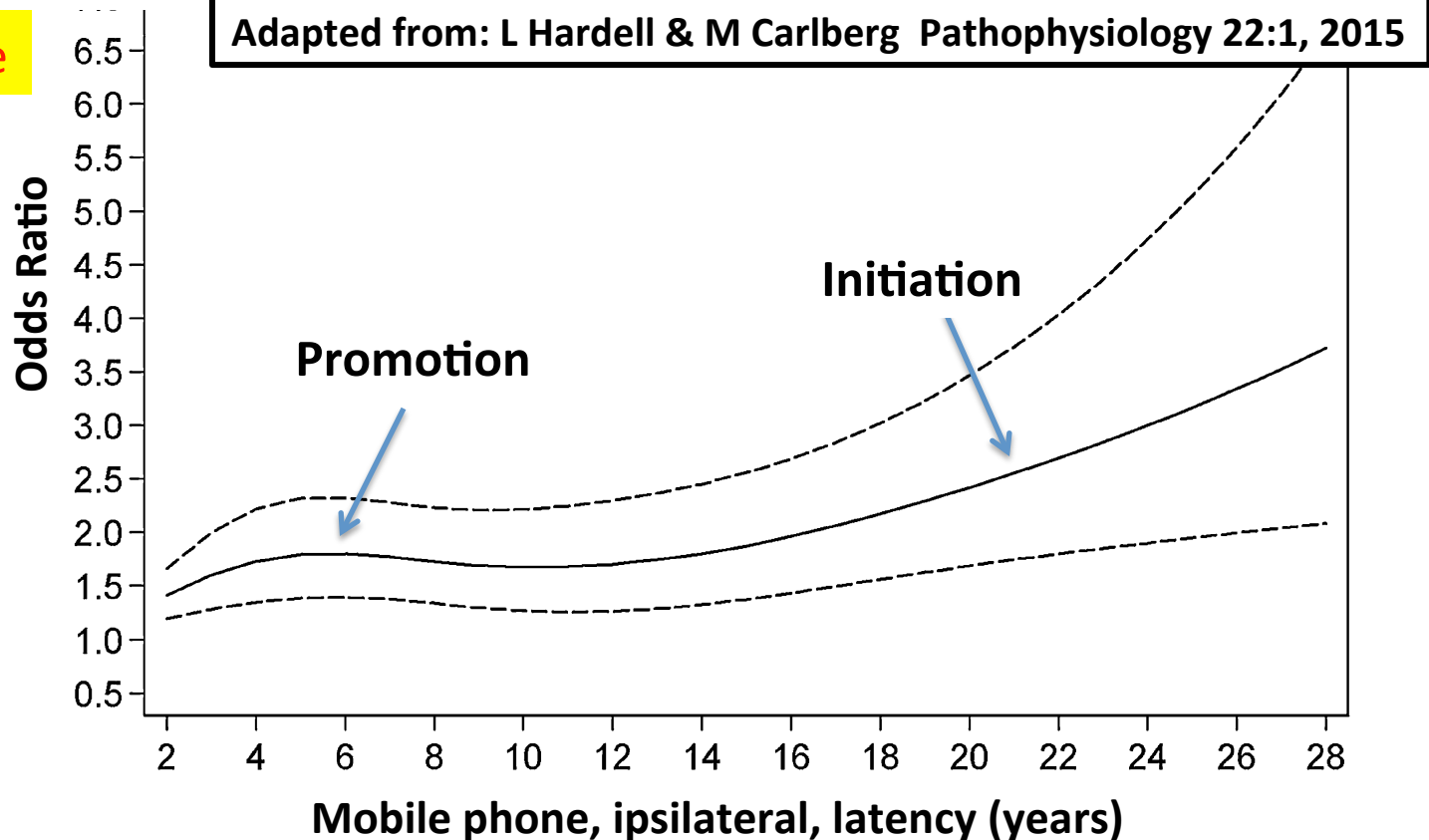


Figure: Plot of relationship between latency of same-side phone use and glioma

- Mobile phone radiation acts as both initiator (long time for tumor development) and promoter (earlier development of already initiated tumor)

# RF-EMF and Tumor Promotion (Humans)

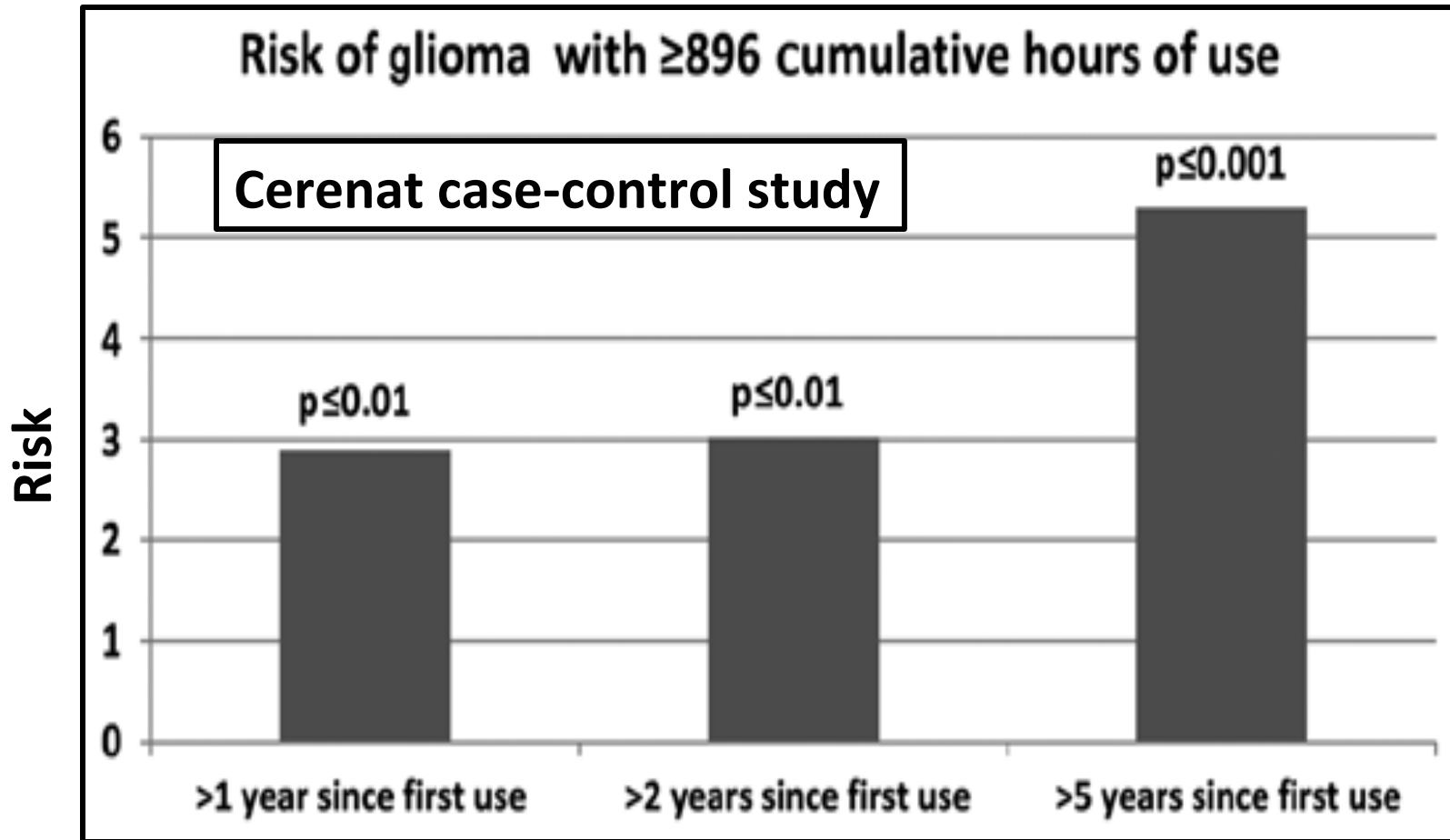


Fig. Risks among mobile phone users with increasing years of use

- Risk increased 3 times after only 1-2 yrs of use (~ 2hr/day).
- Also, reduced survival of glioblastoma patients linked to long-term use of wireless phones.

# RF-EMF and Tumor Promotion (Mice)

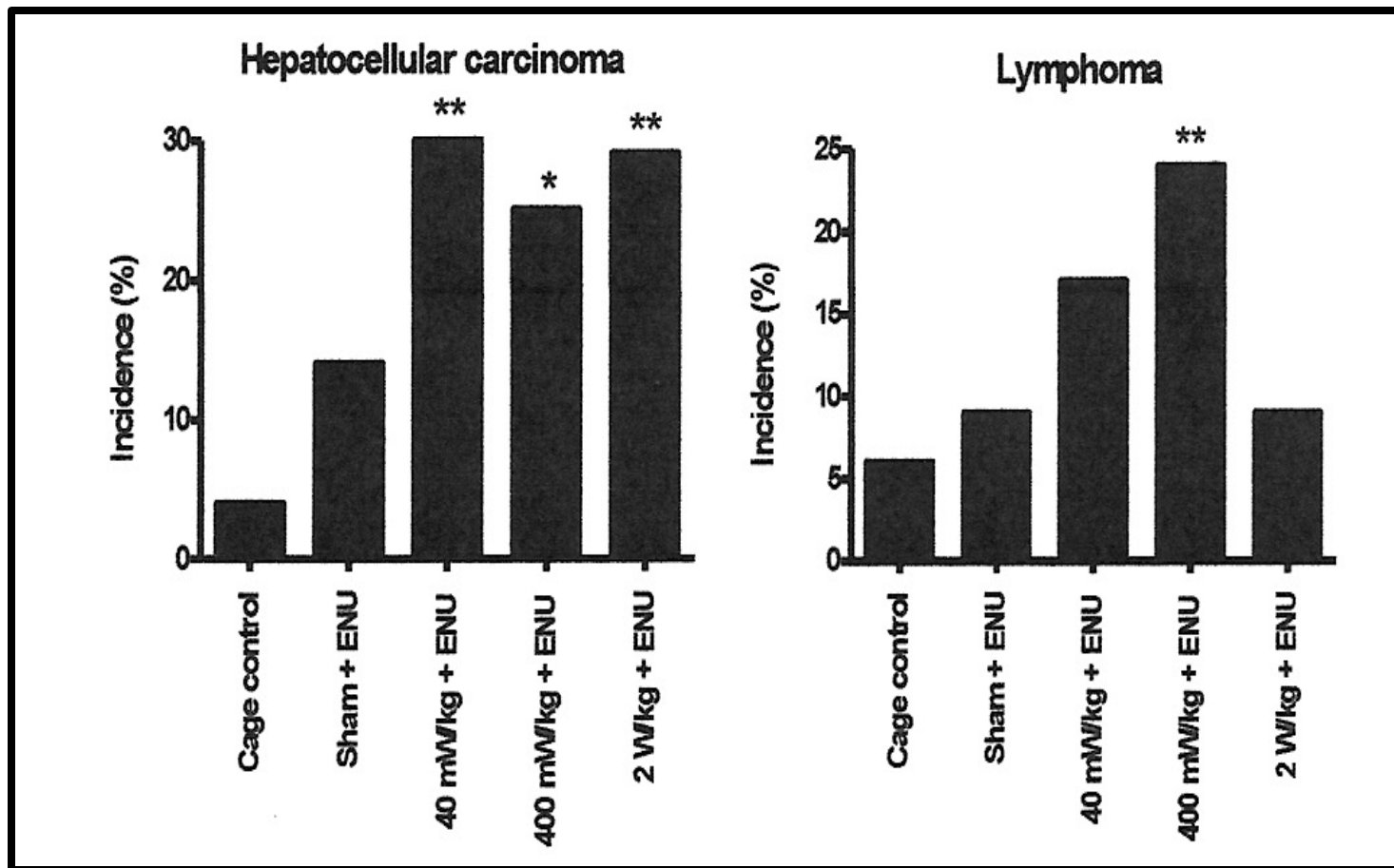
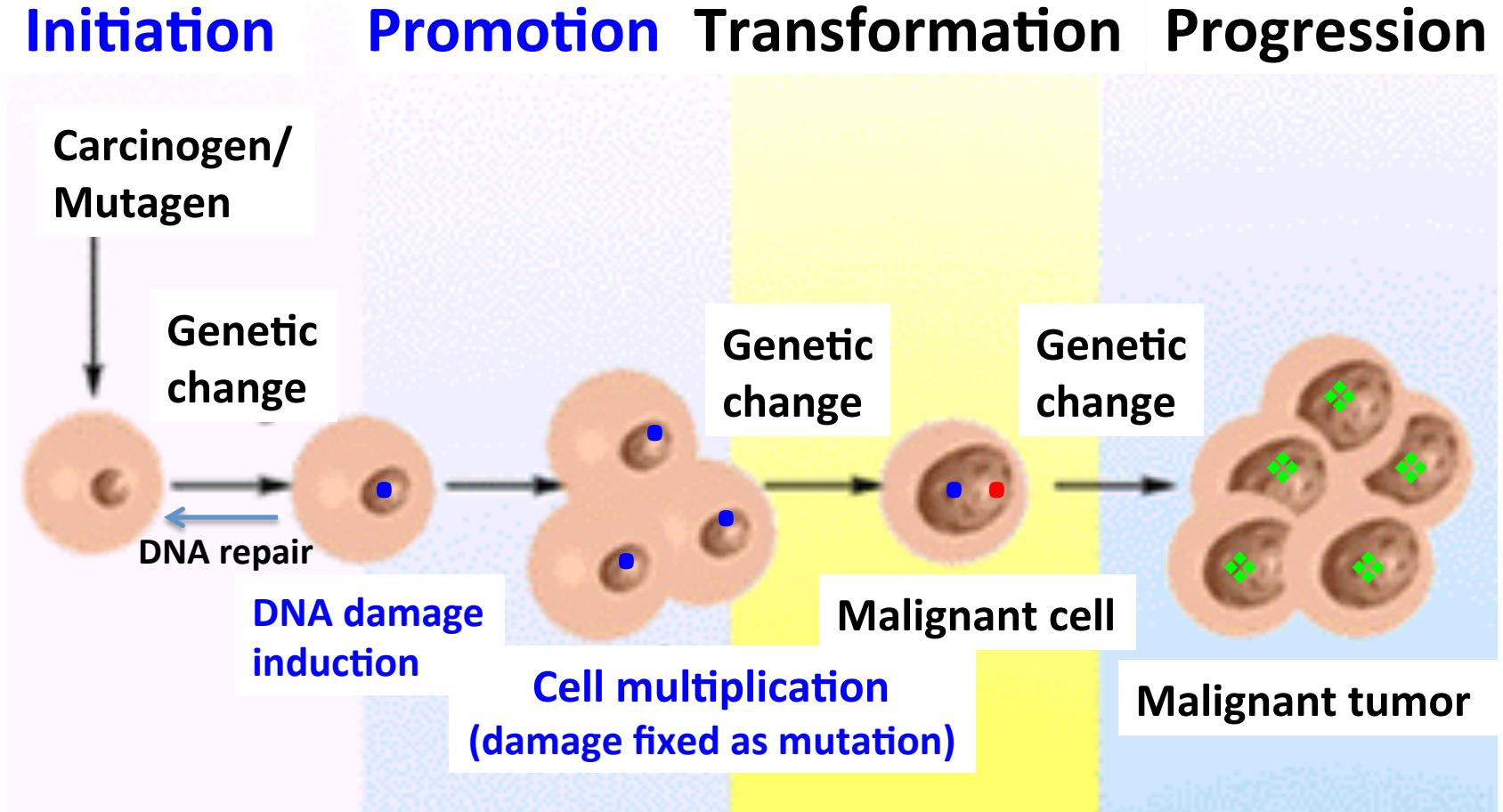


Fig. Effects of life-long (72-wks) exposure to RF-EMF in mice treated with ENU in utero. Tumor incidences given as percentage of animals (93-96 per group)

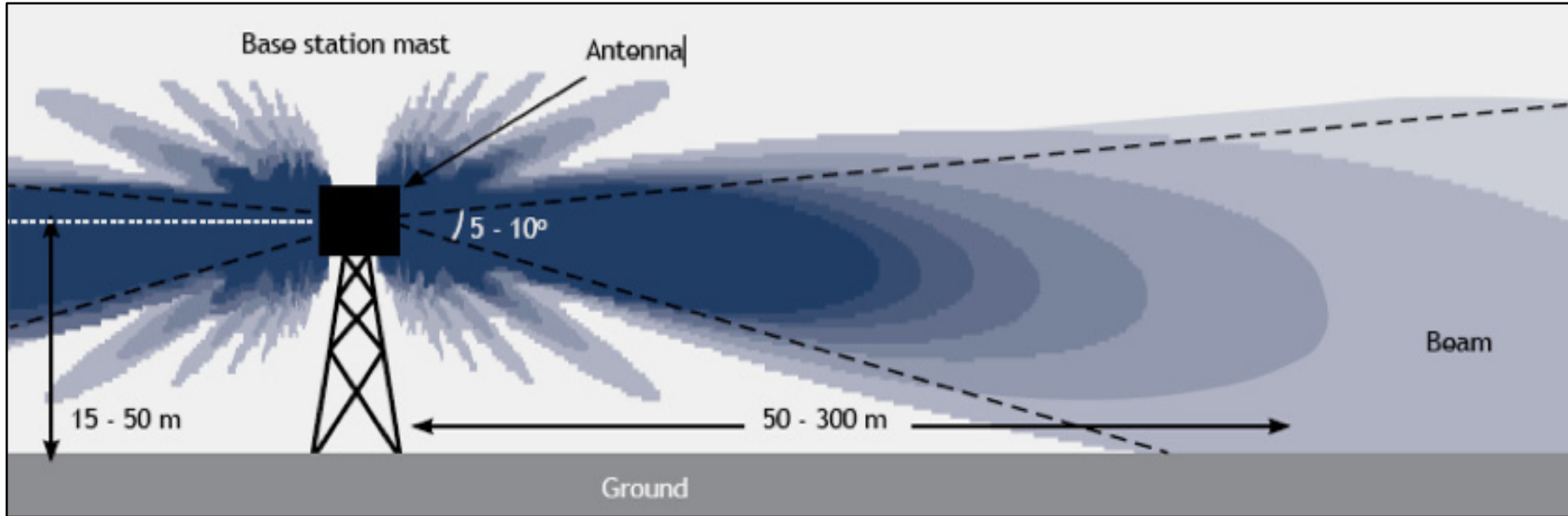
**Promoting effects** seen at **low to moderate exposure levels** (0.04 and 0.4 W/kg SAR); **well below limits** (2 W/kg local exposure) for phone users. **No dose-response effect.**

# Stages in Cancer Development



- Compelling evidence RF radiation acts as both initiator and promoter based on human, animal and cellular studies
- If true, this finding is critically important in advancing cancer control efforts.

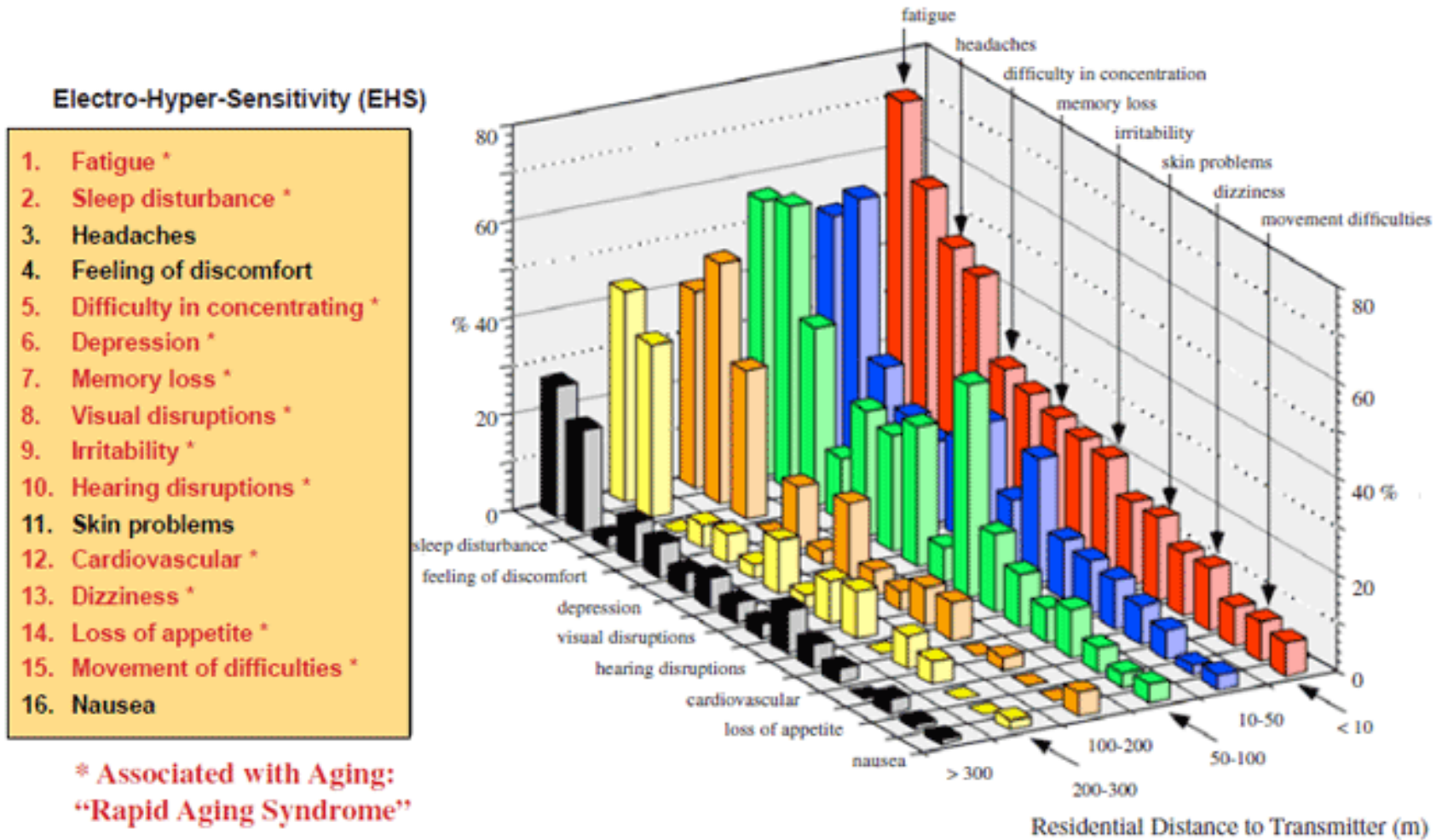
# Radiation Pattern of a Cell Tower Antenna



Propagation of "main beam" from antenna mounted on a tower or roof top

**People living within 50 to 300 meter radius are in the high radiation zone (dark blue) and are more prone to ill-effects of electromagnetic radiation**

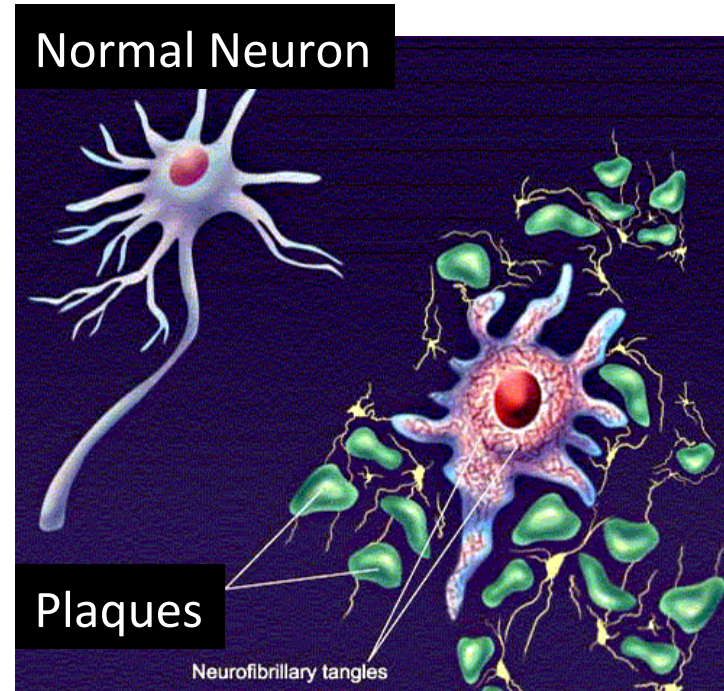
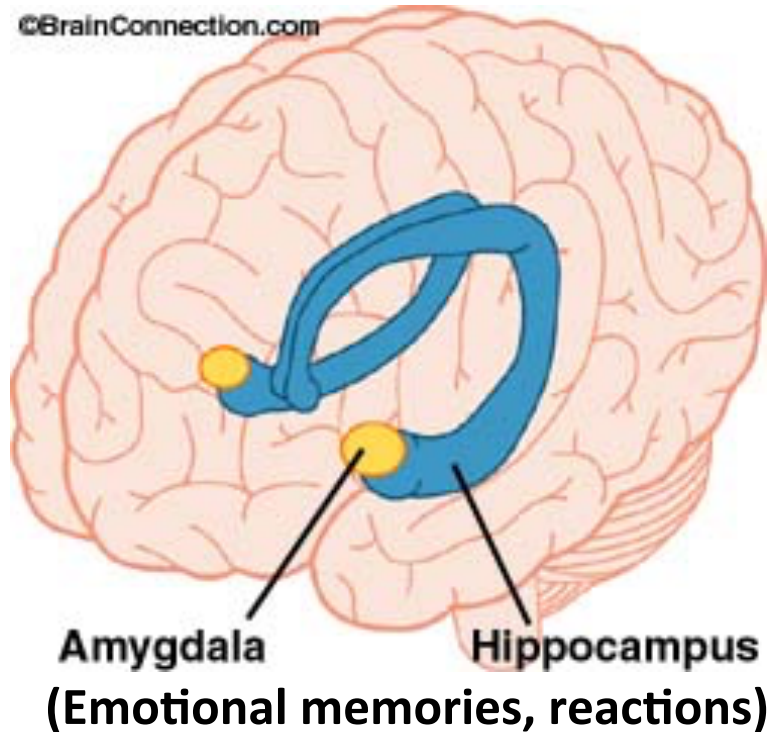
# Frequency of EHS Symptoms Based on Distance to Cell Phone Base Station



Source: M. Havas derived from Spanish study in La Presse Medicale, 2001

# Alzheimer's Disease – EMF Connection

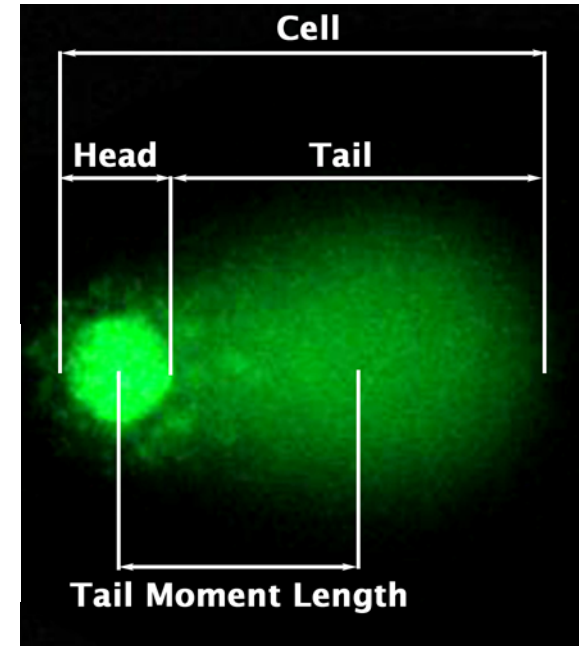
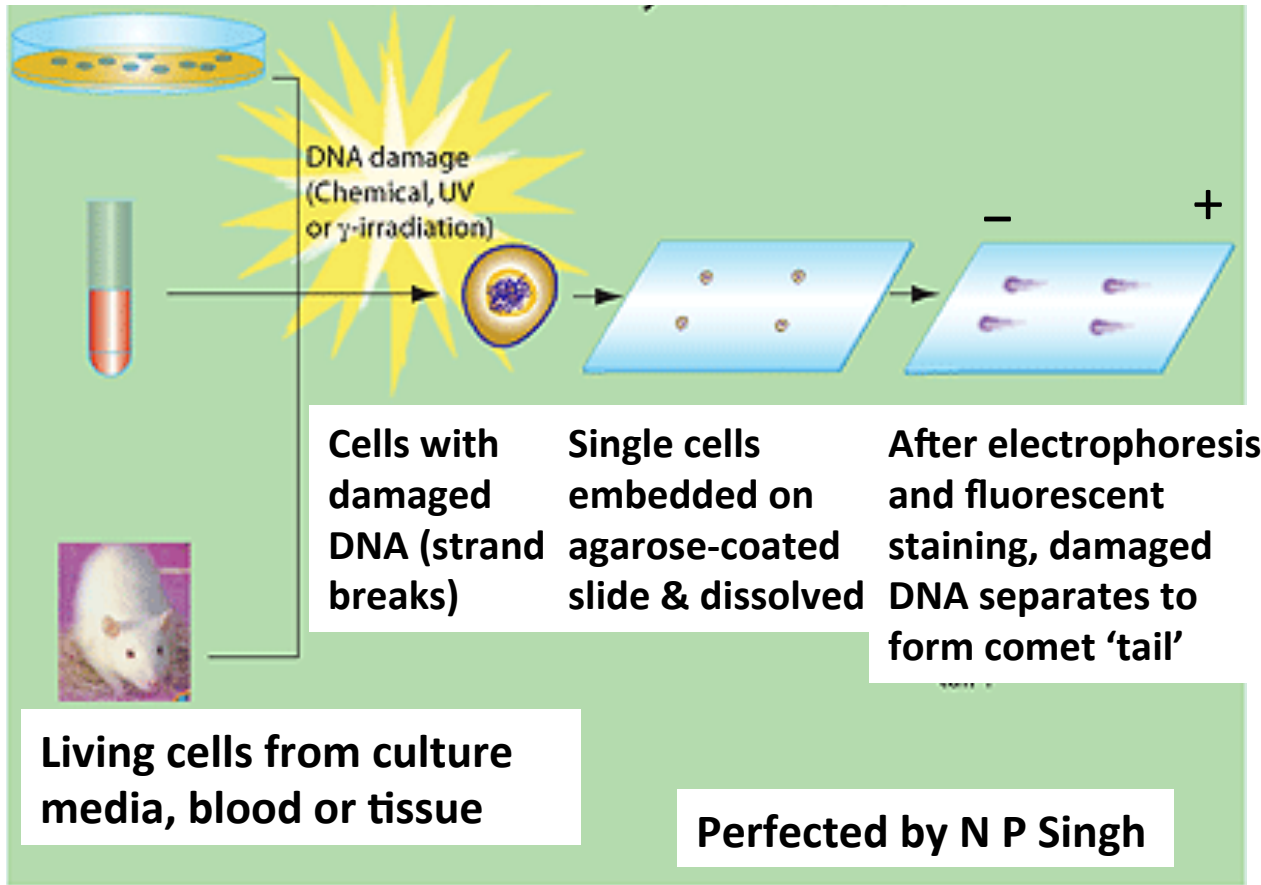
©BrainConnection.com



- AD linked to previous work in jobs with medium-to-high ELF-EMF exposures (2-10 mG)
- 3-5 fold increased risk for radio/TV and power plant workers, electricians, seamstresses
- EMF exposure can produce rise in intracellular  $\text{Ca}^{2+}$  levels, triggering production of peripheral amyloid beta, high levels in brain is risk factor for AD
- EMF exposure can lead to reduced melatonin levels & BBB leakage: 2 other AD risk factors.

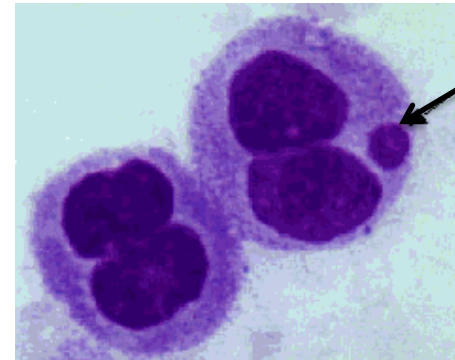
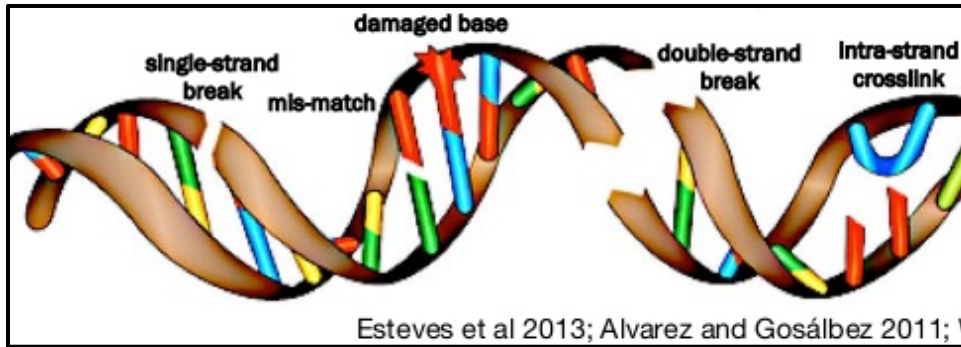


# Comet Assay: DNA Strand Breakage



- **Extremely sensitive: 10 cGy of X-rays**
- **Difficult to master: proteinase K treatment to digest proteins is vital; use of antioxidants**

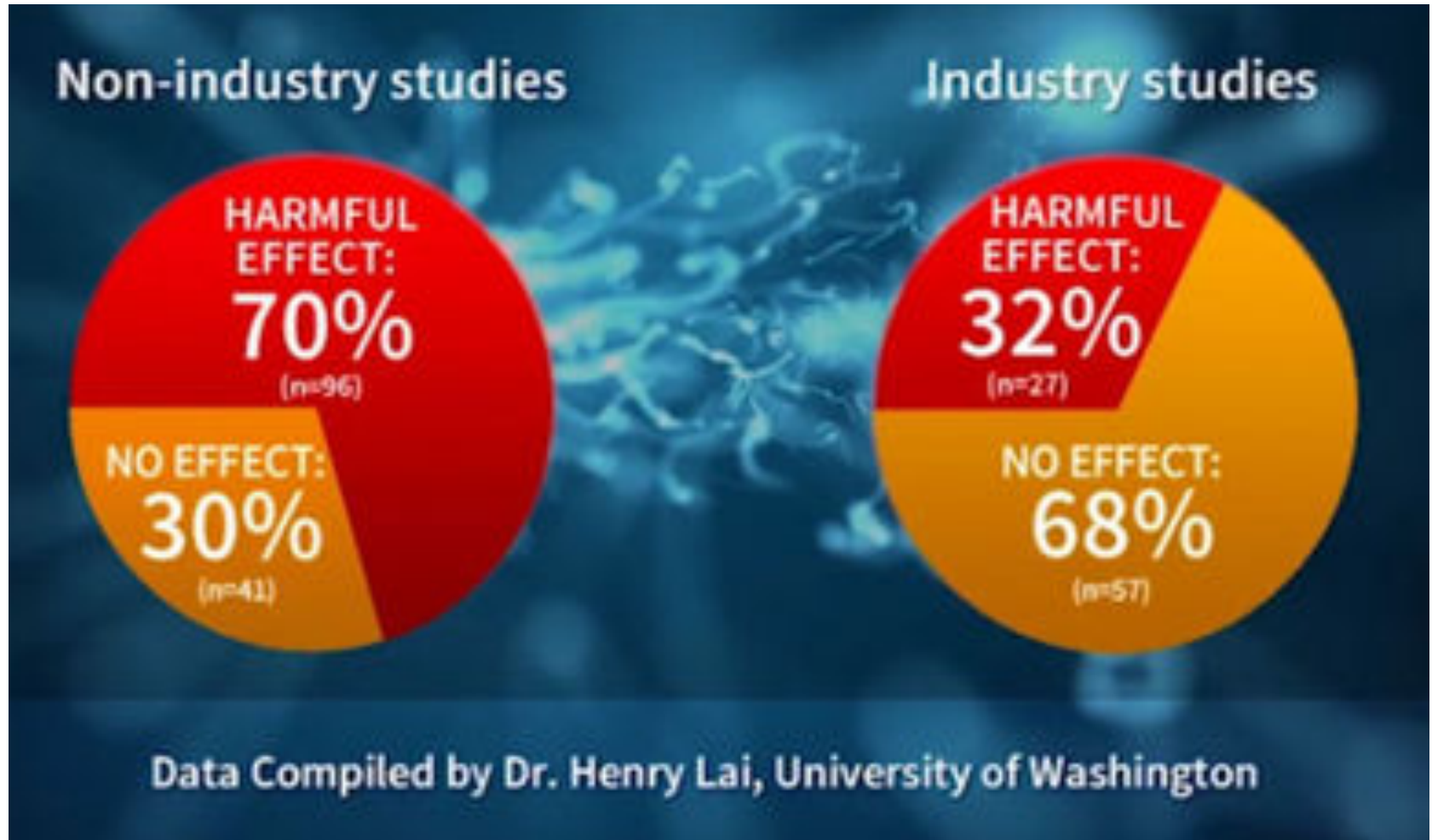
# Genotoxic Effects of RF-EMF



<p>Sham</p> <p>Comet Assay - a typical picture after RF-EMF-exposition of HL60 leukaemia cells Image source: Adlkofer (2004).</p>	<p>Gamma-irradiation, 0.5Gy (1,600 chest x-rays)</p>	<p>24h mobile phone, RF-EMF, 1800MHz at SAR = 1.3W/kg. ICNIRP/WHO = 2W/kg</p>

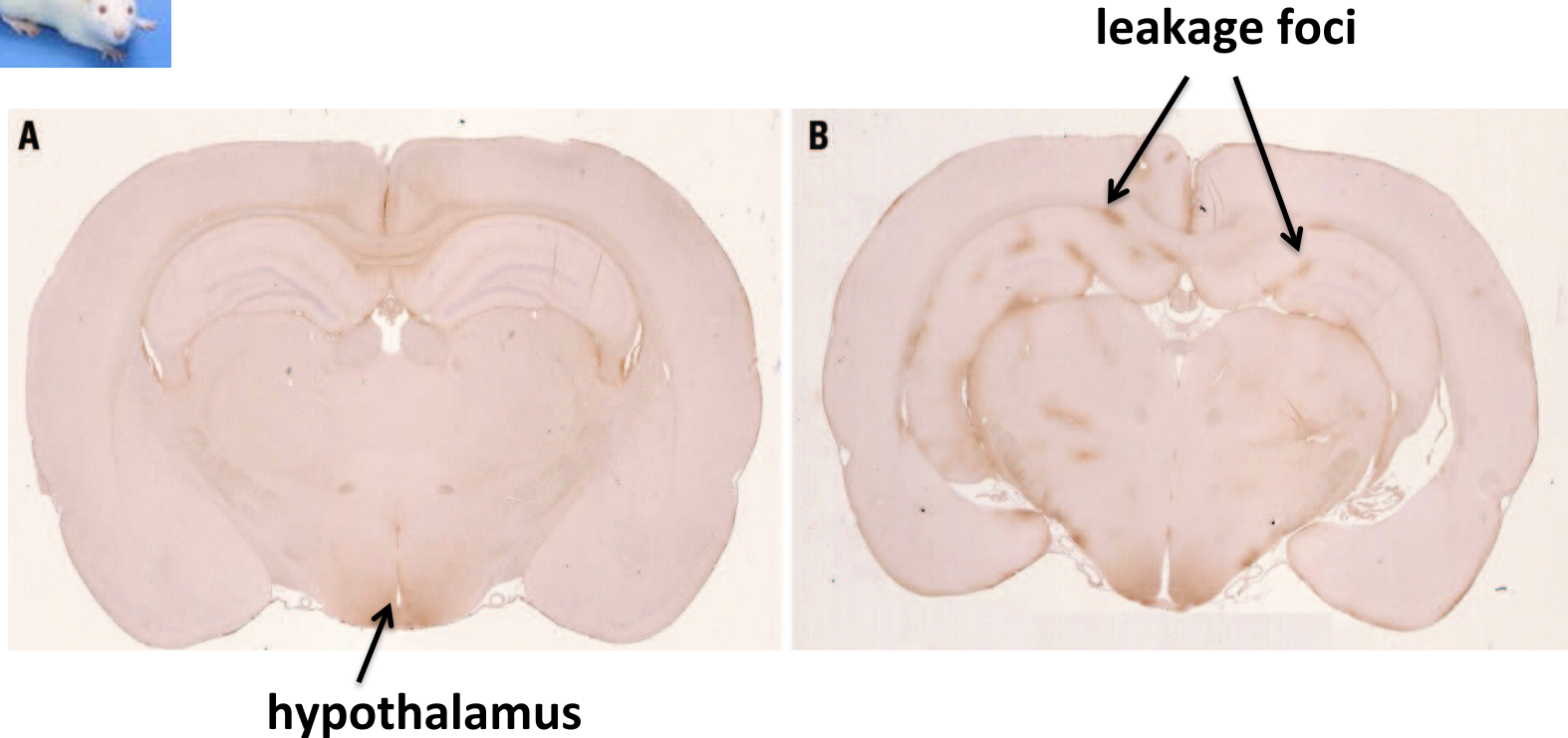
- Review of 101 published studies (SAR: below 0.05 up to 100 W/kg)
- GT(+) 49; GT(-) 42; enhanced genotoxic effects of other agents (8)
- Results independent of RFs from 300 MHz-7.7 GHz
- ‘Ample evidence RF-EMF alters genetic material of exposed cells in many ways.’

# RF Research: Does Funding Source Matter?



- Clearly, it does.

# Leakage of Blood-Brain Barrier from GSM Cell Phone Exposure in Rat



Cross-section of central part of brain stained for albumin (brown)

A. Sham-exposed (control) animal    B. Exposed animal (2 mW/kg for 2 hr)

- Albumin (protein component of blood): does not normally cross BBB
- Neurons clustered & shrunken with disrupted internal cell structure



# BioInitiative 2012

## A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation

BioInitiative Working Group 2012

29 authors: 9 MDs, 21 PhDs

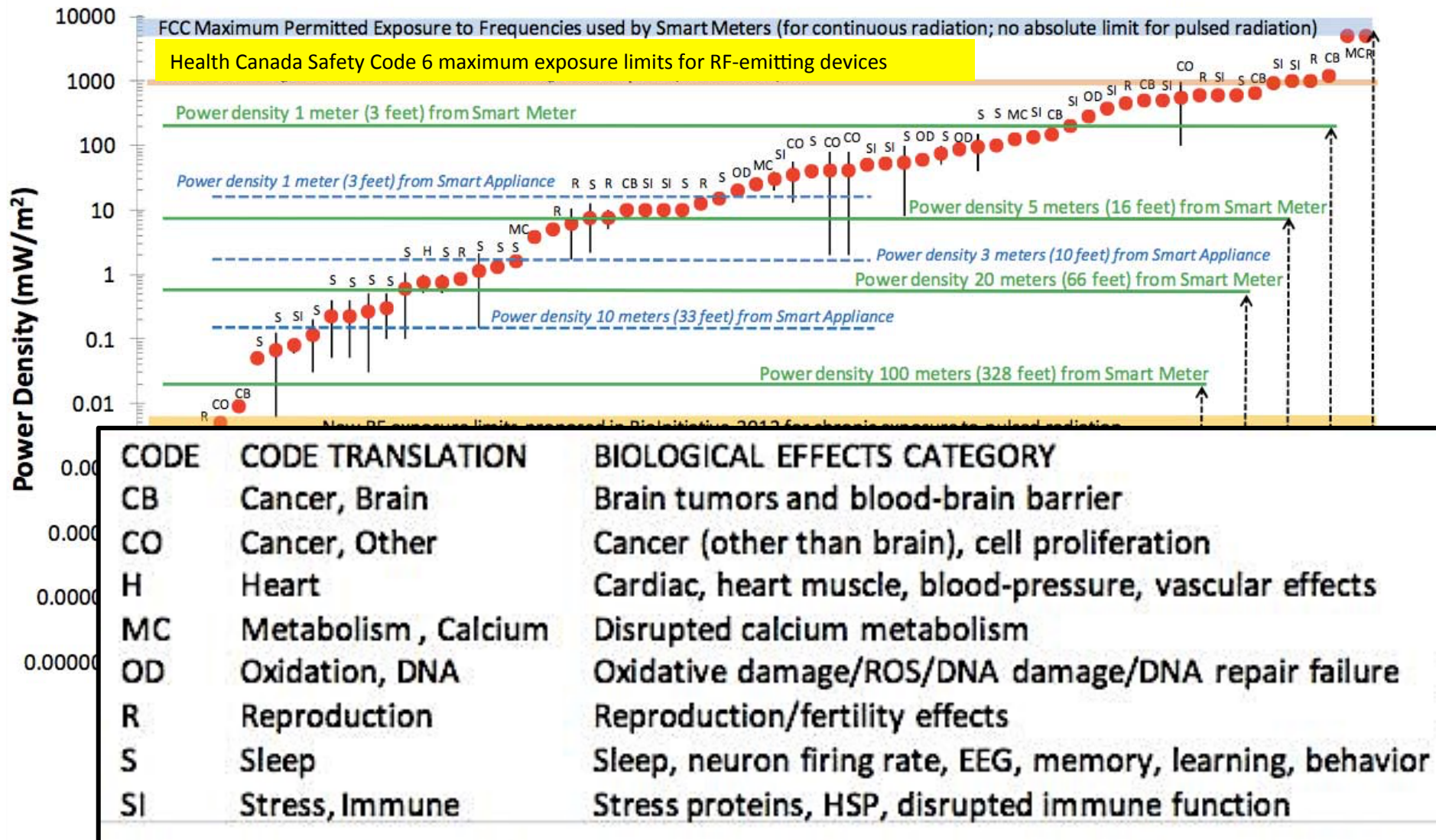
10 countries: USA (10); Sweden (6);

Austria, Canada, Greece, Italy, India (2  
each); Russia, Slovak Republic, (1 each)

- Documents “bio-effects, adverse health effects & public health conclusions about impacts of both ELF-EMF & RF-EMF”
- Billed as benchmark for good science & public health policy
- Advocates much lower exposure limits:  $0.1 \mu\text{W}/\text{cm}^2$

<http://www.bioinitiative.org>

# Reported Biological Effects from RF Radiation at Low-Intensity Exposure in 67 Studies in *BioInitiative Report 2012*



# **Sensitive populations**

**Need to protect: developing fetus, children, elderly, those with medical implants, chronic diseases or acquired electro-hypersensitivity**

# Children are not little adults

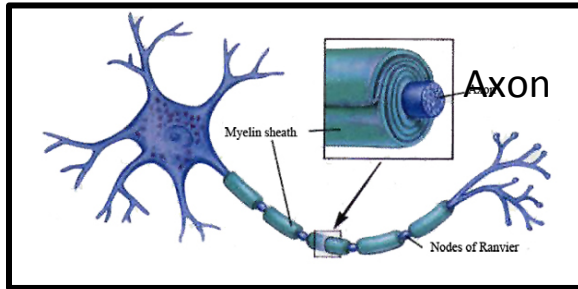


*Family and Rainstorm 1955*  
*Alex Colville*

1. *Different and unique exposures*
2. *Dynamic developing nervous and immune systems*
3. *Longer life expectancy*
4. *Politically powerless*



# Children Are More Vulnerable

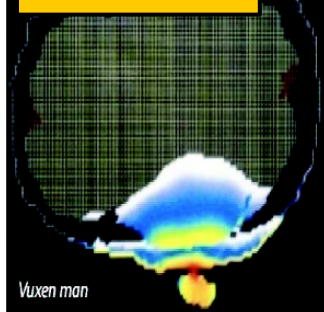


- Smaller body mass; rapid physical development
- Brain not fully developed until early 20's; sensitive to toxins as protective sheath (myelin) around neurons still forming
- Smaller head & thinner, softer skull bone (bone marrow absorption 10X greater)
- Brain tissue has 2X higher conductance
- Thus absorb greater amount of RF energy deeper into their brain than adults
- Earlier age of phone use, greater glioma risk.

*“It is **essential** that any **new standards** for cell phone or other **wireless devices** be based on **protecting the youngest & most vulnerable** ....”*

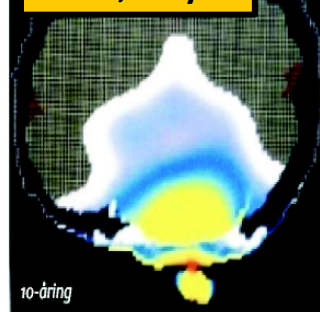
American Academy of Pediatrics (2012)

Adult man



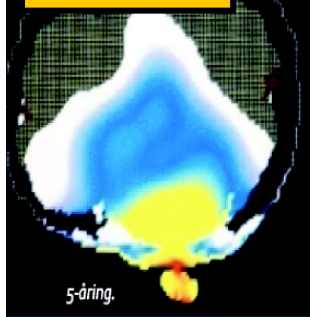
Vuxen man

Child, 10 yrs

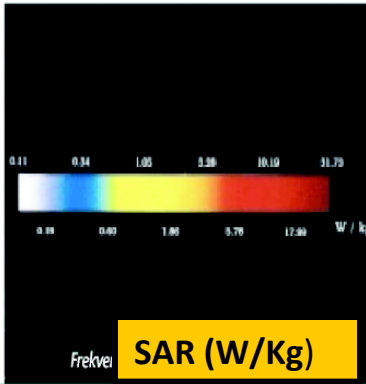


10-åring

Child, 5 yrs



5-åring.



Frekvei

SAR (W/Kg)

Brain activity, GSM phone (900 MHz)

Abridged from OP Gandhi, 1996

# Health Canada: “Busting Myths on Safety Code 6”



**Myth:** “Frequent users of cell phones, such as children and teenagers, are at an increased risk of adverse health effects caused by exposure to RF energy.”

**Fact:** “*There is no evidence that children and teenagers are at increased risk when Safety Code 6 exposure limits are respected.*”



...“Health Canada encourages parents to limit their children's use of cell phones, as children are often at increased risk from a variety of environmental factors.”



**‘Get your facts first, and then you can distort them as you please’.**  
Mark Twain



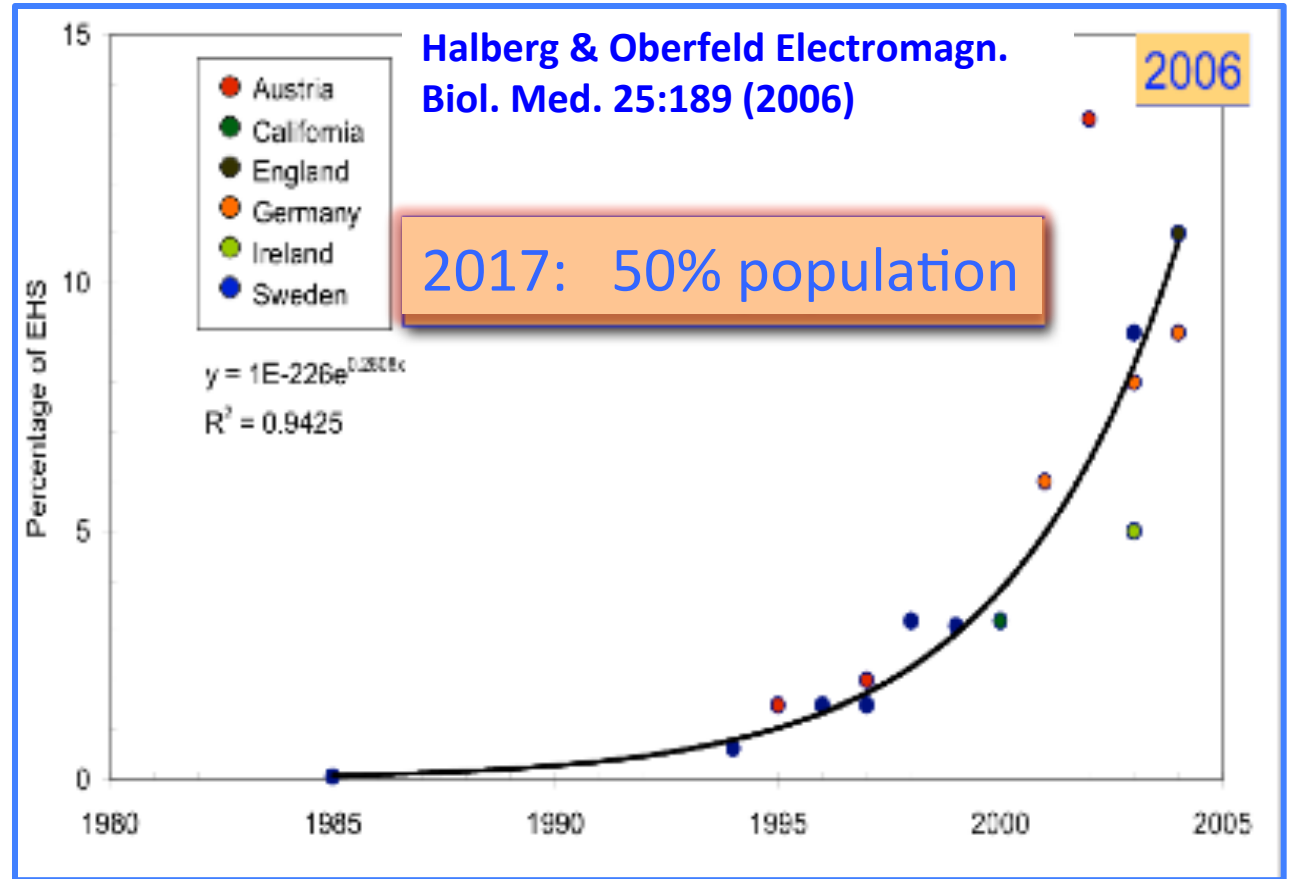
# Electro-Hypersensitivity (EHS)

- **Non-specific, multi-system, debilitating condition triggered by everyday levels (0.5% of existing Health Canada limits) of non-ionizing EMR**
- **Signs and symptoms include: fatigue, headache, memory loss, heart palpitations, sleep disorder, blurred vision, dizziness, muscle pain, tinnitus, chest discomfort, seizures, stroke**
- **Many rendered disabled and socially dysfunctional ('loner's disease')**
- **Imperceptible nature, lack of objective clinical markers; diagnosis often dismissed as psychosomatic, leaving individual annoyed and frustrated**
- **Treatment includes avoiding environmental triggers, reducing toxicant loads; when effective, excludes Rapid Aging Syndrome, fibromyalgia**
- **Few clinicians trained to diagnose and treat EHS persons.**

# Estimated Prevalence of EHS in Various Countries



**230,000 with EHS in BC?**

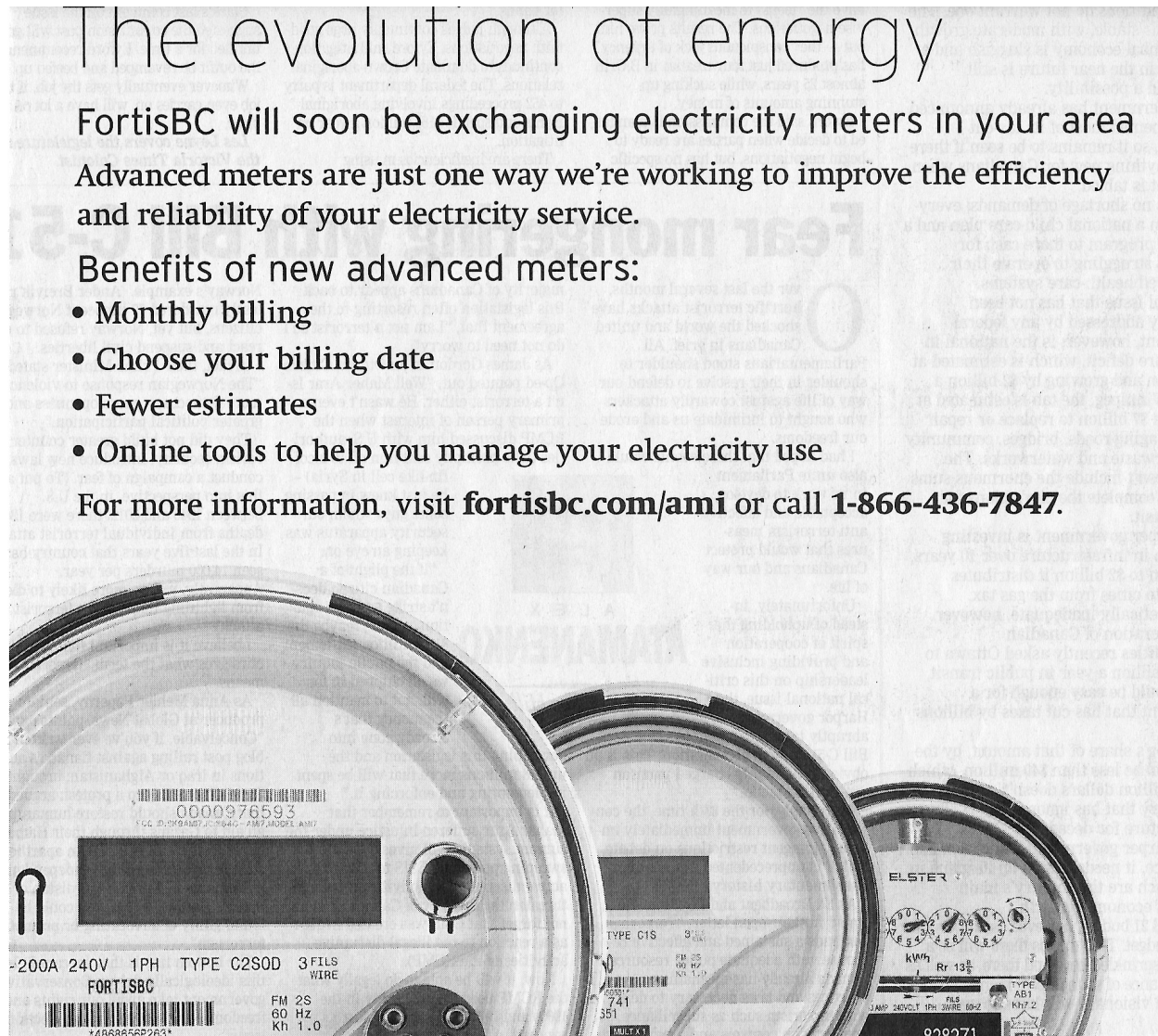
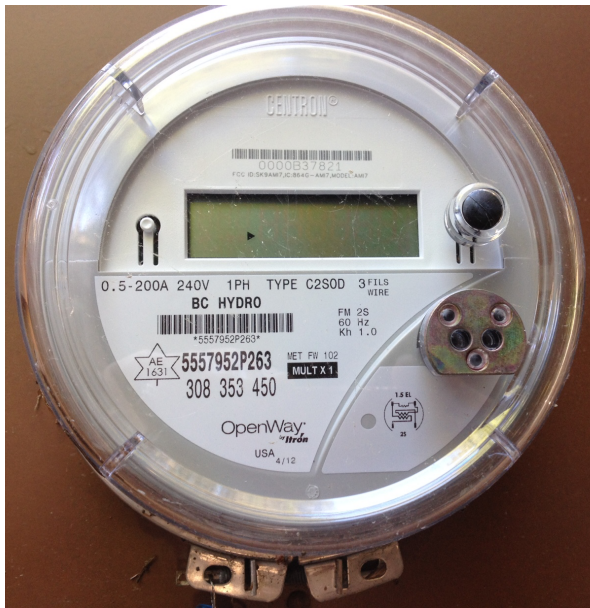


- **Varies widely (4-10% population); rising rapidly**

# Smart Meters are coming our way in RDOS



*Knowledge to Shape Your Future*



## The evolution of energy

FortisBC will soon be exchanging electricity meters in your area

Advanced meters are just one way we're working to improve the efficiency and reliability of your electricity service.

Benefits of new advanced meters:

- Monthly billing
- Choose your billing date
- Fewer estimates
- Online tools to help you manage your electricity use

For more information, visit [fortisbc.com/ami](http://fortisbc.com/ami) or call 1-866-436-7847.

Take a  
**BREAK**



**Smart meter/grid technology**

# What are Smart Meters?



Analog (old) Meter



Digital (Smart) Meter

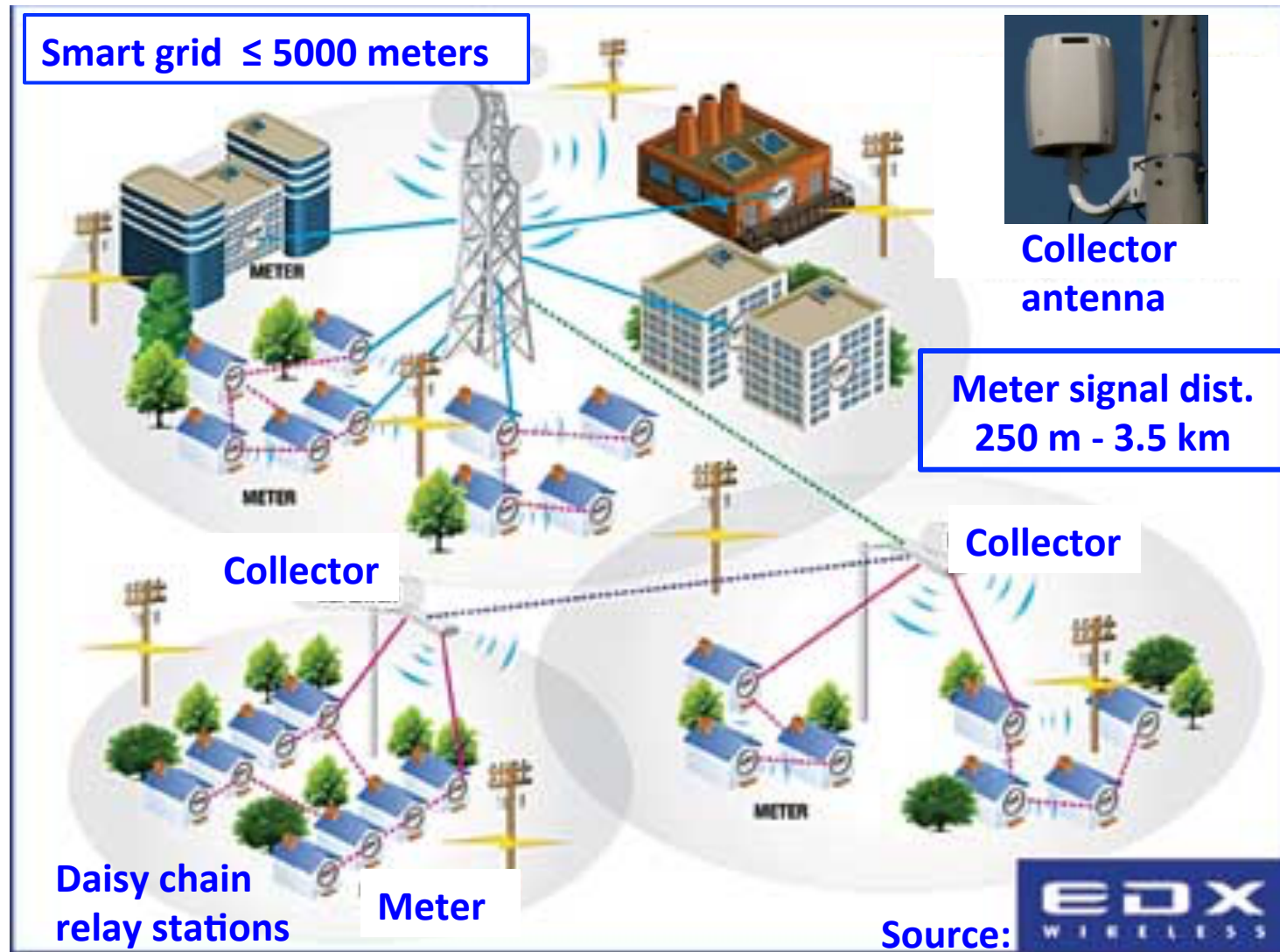


OpenWay

- Measure properties of electricity, natural gas or water delivered to consumers & transmit info digitally to utility companies
- Transmit real-time usage data; radio with 2-way transmitter/receiver antenna (902-928 MHz; 4 W effective radiated power; 64 channels) to 'talk' to utilities
- Fitted with WiFi (ZigBee) chip (2.4 GHz) to link appliances and devices wirelessly
- Once fully operative, as many as 15 smart appliances & devices in smart home will be able to exchange info with utilities 24/7.

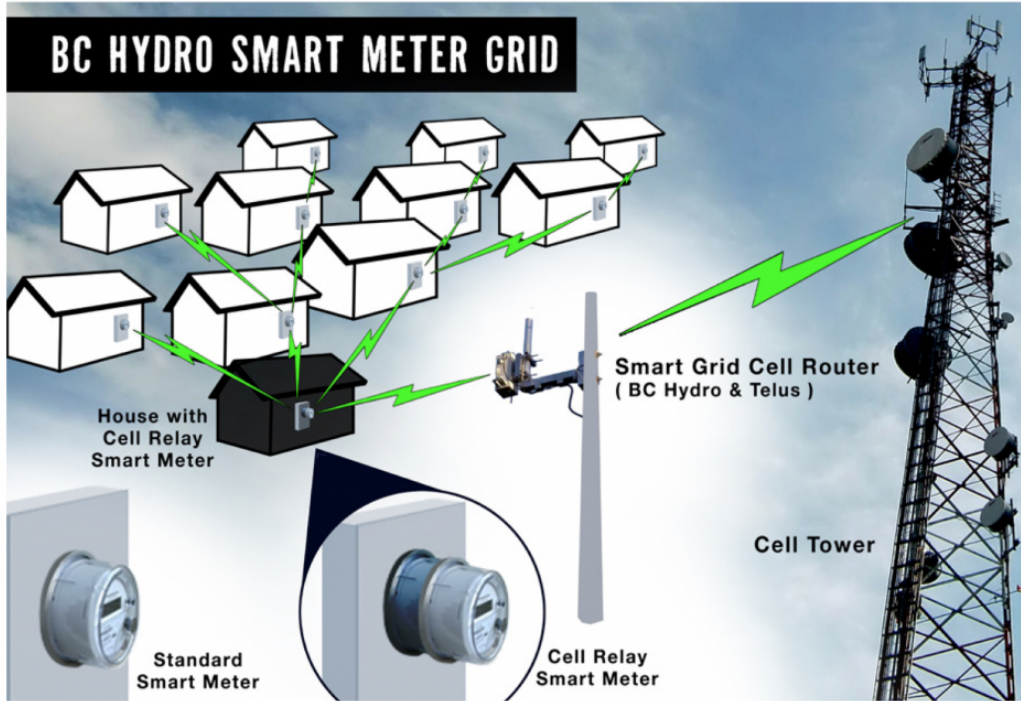


# AMI Smart Grid

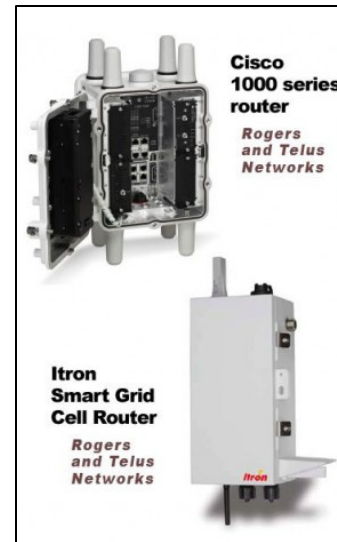


- Smart meters form mesh network exchanging info with utility access point.
- EM waves travel in straight line; topography & buildings interfere with data flow.

# Smart Meter Grid Components



**Itron  
Openway  
Cell Relay**



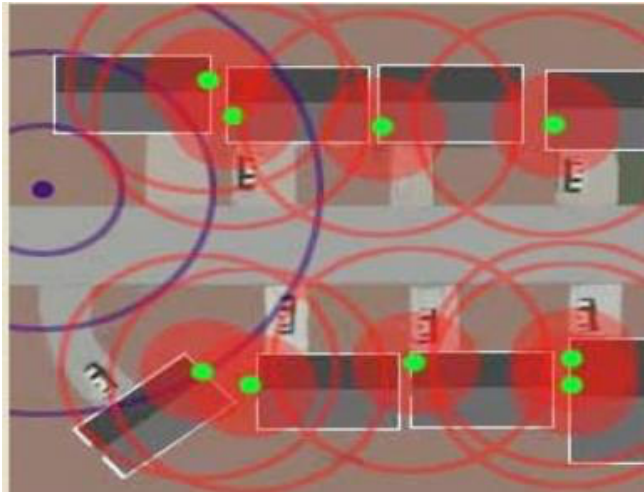
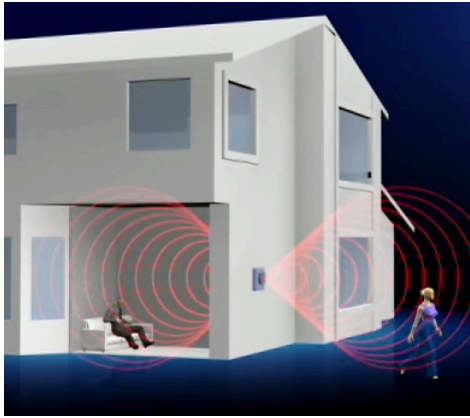
## Four Components:

- Standard smart meter
- Cell relay smart meter
- Smart Grid Cell Router
- Cell Tower

**Cicso: 8 transmitters**

**Itron: 2 transmitters**

# Mesh Network



- **Regardless of where signal ends up, smart meters transmit in all directions**
- **Significant amounts can penetrate walls into living area even from other meters**
- **Banks of meters in condos of particular concern (e.g. if against bedroom wall)**
- **Exercising option to decline smart meter installation may be irrelevant, depending upon housing density and landscape**
- **'Community-level opt out' to installation is only practical solution.**

# Itron OpenWay Smart Meter Transmissions in a 24-Hour Period

	Duty Cycle	Time (Sec/Day)
Mean	0.06%	53.14
Maximum	0.58%	497.8
Minimum	0.02%	18.31
Median	0.06%	49.81

- Transmit time statistics for ~ 7,000 meters
- Each transmit burst **less than 150 mSec**; more than **350 bursts per day**.



[https://www.itron.com/na/PublishedContent/OpenWay  
%20Wireless%20Transmissions\\_24%20Hour%20Duty%20Cycle.pdf](https://www.itron.com/na/PublishedContent/OpenWay%20Wireless%20Transmissions_24%20Hour%20Duty%20Cycle.pdf)

# Residential Smart Meter Transmission Statistics (24-hour period)<sup>¶</sup>

	Average daily no. of transmissions	Average daily transmission time	Maximum daily transmissions <sup>£</sup>	Max. daily transmission time (sec)
RF LAN radio	1,268	53 sec	25,916	68.3 min
ZigBee radio	5,768 <sup>§</sup>	9.9 sec	No change	No change

<sup>¶</sup> Derived from deployment sample of over 6,800 Itron OpenWay meters

<sup>£</sup> 97% transmit fewer than 2,500 times in 24-hr period

<sup>§</sup> Currently, zero or 1 device/meter; in future **~50,000 (864 sec)** based on **8 devices**

- Transmit amongst each other to monitor communication paths & topography
- 90% 'chatter' for network command and control (synchronization, security, data integrity, self-healing)
- 10% for meter data (scheduled and/or on-demand)

Source: Southern California Edison Company's Response to Administrative Law Judge's Ruling Seeking Clarification, Nov 2011 (Before Public Utilities Commission, State of California)

# Time-averaging RF Emissions Erase Peak Spikes

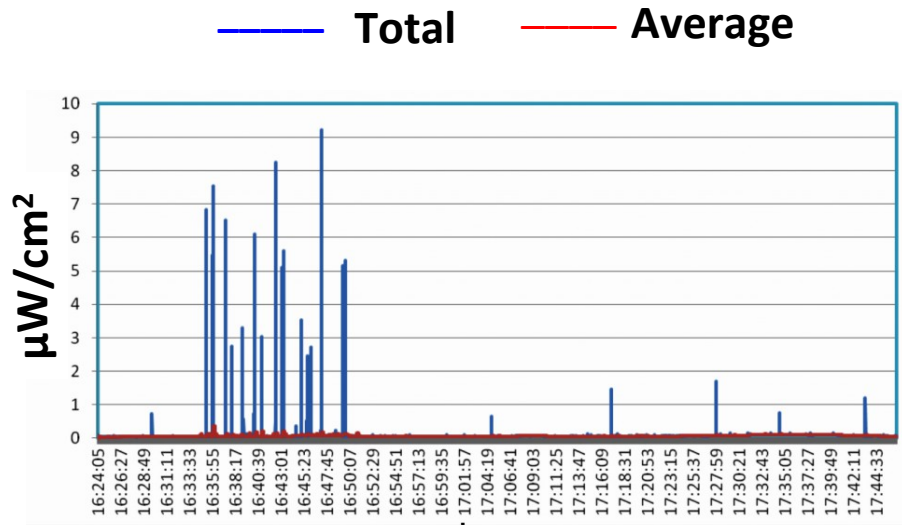
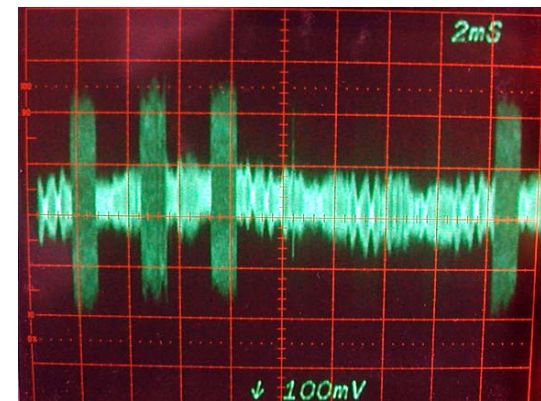


Chart illustrating stark difference between averaged (red) and actual (blue) RF power density levels measured from a smart meter

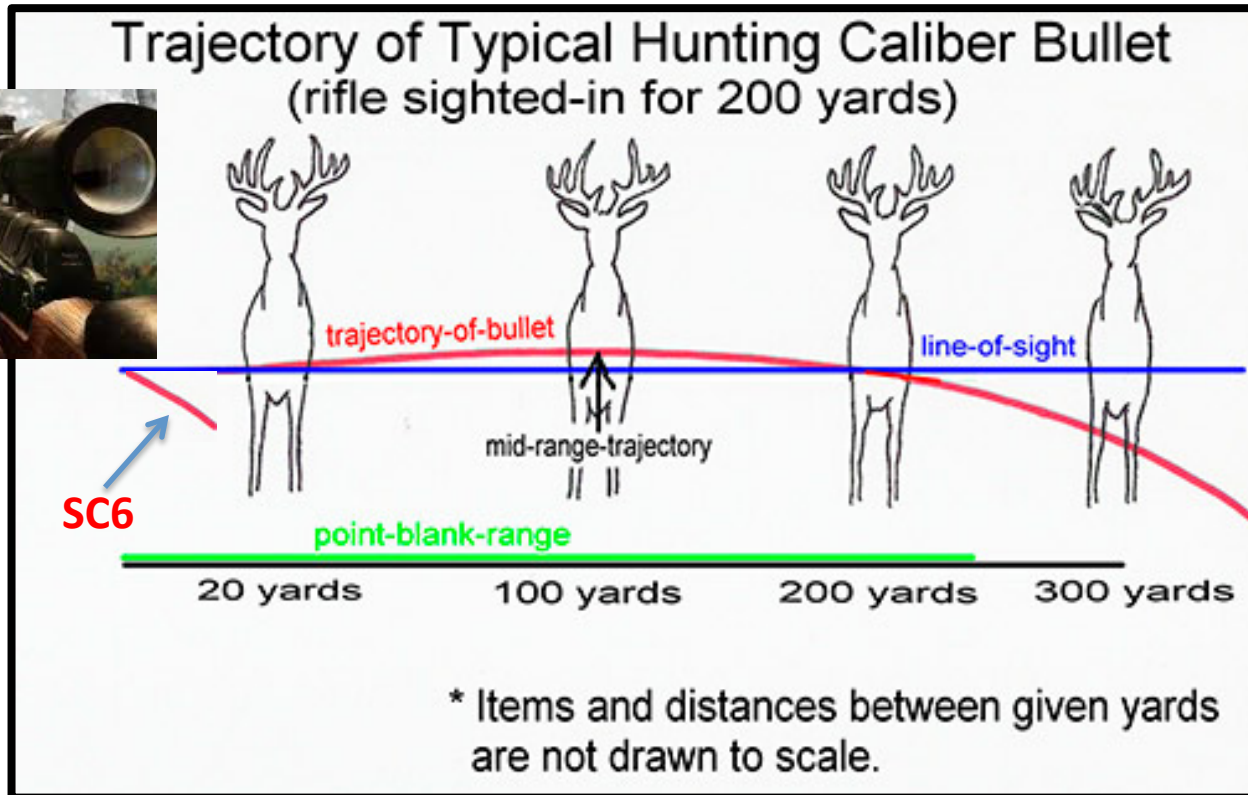
Source: EMF&RF Solutions, [www.EMFRF.com](http://www.EMFRF.com)

- **Maximum power density** ( $417 \mu\text{W}/\text{cm}^2$ )<sup>¶</sup> of smart meter's **mSec pulses exceeds** Health Canada **safety limit** ( $274 \mu\text{W}/\text{cm}^2$ ) by **50%**, yet when **averaged over 6 min** appear to be **far below it**.
- **But a person in field actually faces intense bursts of RF energy at levels shown to have biological effects.**



<sup>¶</sup>Certification Exhibit RF Exposure Itron Model AM17. Advanced Compliance Solutions Project 12-0261, FCC ID: SK9AM17, p. 2.

# Effect of Applying Safety Code 6 Time-Averaging to Deer Hunting

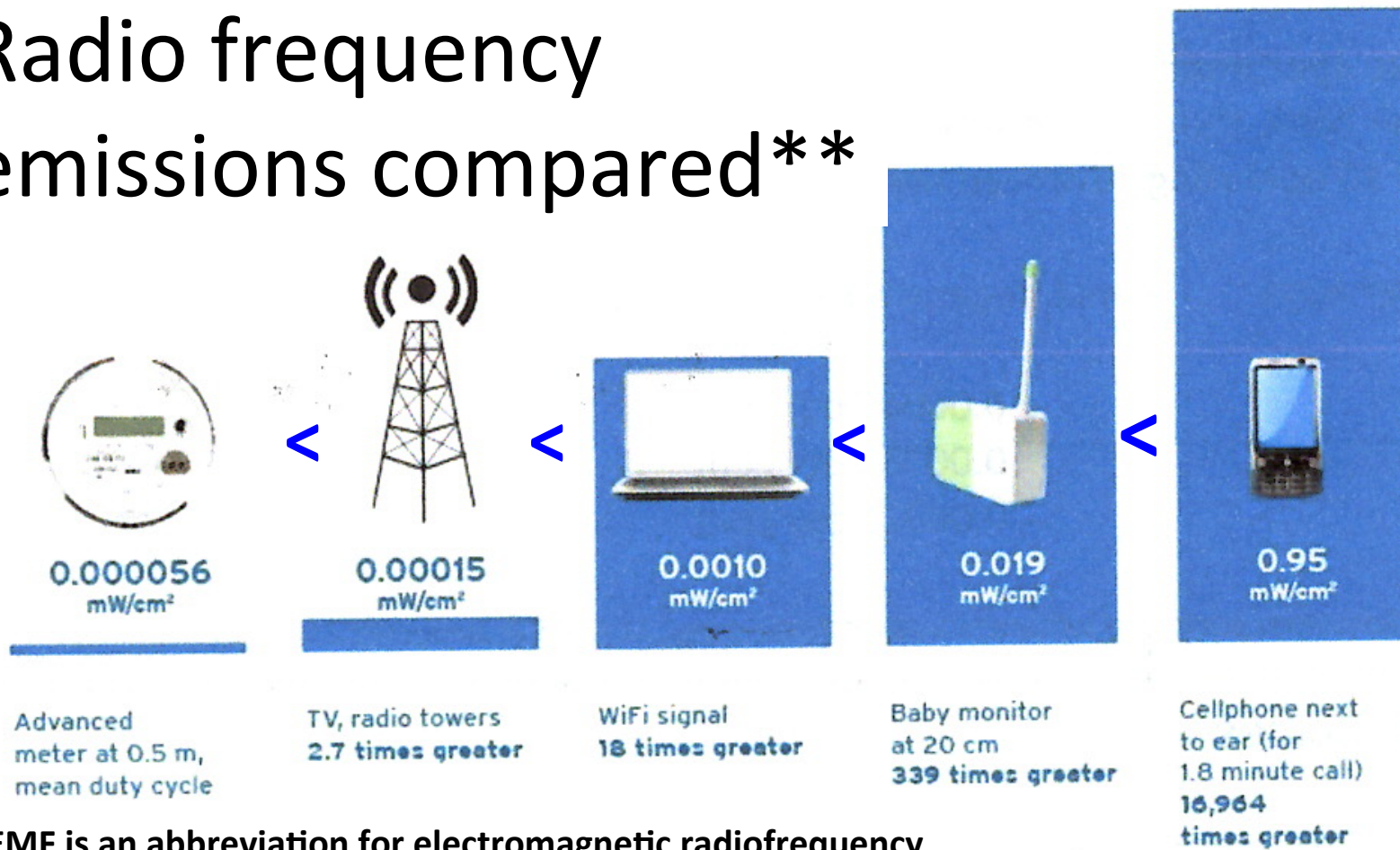


- Muzzle velocity of high performance cartridge from modern rifle is **1200 m/sec**.
- If averaged over 6 min, velocity would be 3.33 m/sec or **200 m/min**.
- At this velocity bullet would quickly fall to the ground without ever reaching its target.

# Advanced meter facts: Health

**2.8 × 10<sup>8</sup> times safer than cellphone!**

## Radio frequency emissions compared\*\*



\*EMF is an abbreviation for electromagnetic radiofrequency

\*\*Measured in milliwatts per square centimeter (mW/cm<sup>2</sup>)

From: YP Shkolnikov

Source: Exponent Report: Status of Research on Radiofrequency Exposure & Health in Relation to Advanced Metering Infrastructure (YP Shkolnikov)



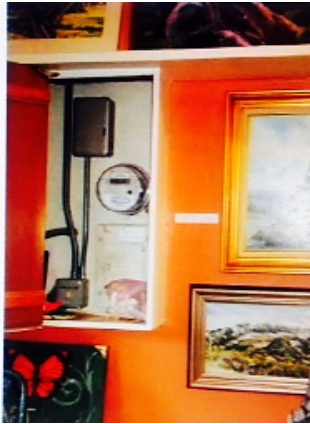
# **Public health impact of smart meter/grid networks**



# Smart Meters Pose No Public Health Risk



“Since RF energy exposure levels are far below Canadian and international safety limits, Health Canada does not consider that any precautionary measures are needed to reduce RF energy exposure from smart meters.

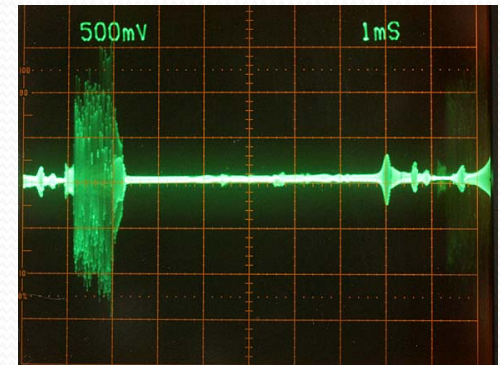


In cases where multiple smart meters are installed together, as in some townhouses or high-rise buildings, the total exposure levels from multiple smart meters will still be far below Health Canada's RF energy exposure limits, due to the infrequent nature of transmissions.”



# Effects of Pulsed RF Radiation

- Causes leakage in blood-brain barrier
- Affects opiate-dopamine neurotransmitters
- Alters heart rate and heart rate variability
- Decreases sperm production in men
- Causes impairment in memory and thought processing
- Lowers melatonin levels
- Pulsed radiation estimated to be 2.5 times more destructive than continuous radiation
- Pulsating, amplitude modulating nature of signal new to all life forms



# Why the Anxiety Over Smart Meters?

1. Their installation is mandatory. Would you mandate lead, DDT, engine exhaust and other 'possible carcinogens' in every home?
2. Emit sporadically in extremely high intensity bursts ( $\leq 150$  msec); signal is foreign to all life forms.
3. When HAN operational, transmission will be in effect continuous, adding greatly to RF radiation in family living space.
4. Potential adverse health effects have never been studied by utility industry prior to deployment.

# International Health & Scientific Bodies Advising Review/Revision of Safety Guidelines for RF EMF

- Bioinitiative Report (2007, 2012)
- Seletun Scientific Panel (Seletun, Norway, 2009)
- European Environmental Agency (2007-2011)
- European Parliament (2007, 2011)
- PACE (Parliamentary Assembly of Council of Europe) (2011)
- **American Academy of Environmental Medicine (2012)<sup>‡</sup>**
- American Academy of Pediatrics (2012)
- Austrian Medical Association (2012)

<sup>‡</sup> Calling for **immediate moratorium** on **smart meter installation**

# Moratorium on Smart Meter Installation



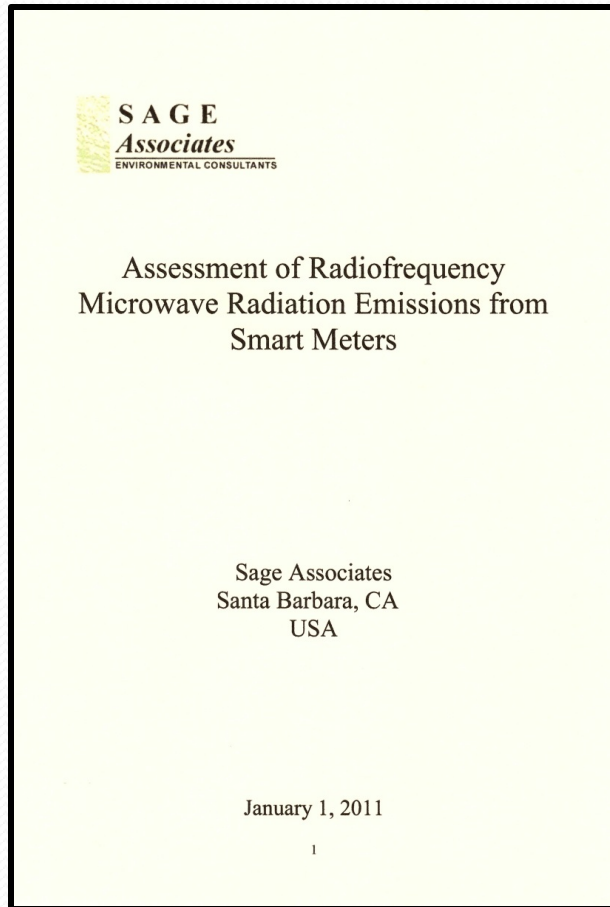
AMERICAN  
ACADEMY OF  
ENVIRONMENTAL  
MEDICINE



AAEM Board letter to California Public Utilities Commission, 19 Jan 2011.

- “Chronic exposure to wireless RF radiation is preventable environmental hazard that is sufficiently well-documented to warrant immediate preventable public health action....
- Given the widespread, chronic and ... inescapable RF exposure of everyone living near a smart meter, the Board finds it unacceptable ... to implement this technology until these serious medical concerns are resolved....
- **Moratorium on installation ... issue of highest importance.**”

# Cautionary Report On Smart Meters



**Purpose:** document RF levels from smart meters in various installation & operational scenarios.

## Conclusions:

- **No positive assertion of safety can be made by FCC regarding pulsed RF in which exposures are chronic & occur in general populations.**
- **Indiscriminate exposure to ubiquitous pulsed RF from rollout of millions of smart meters will mean far greater general population exposure, and potential health consequences.**
- **Uncertainty about existing RF energy levels, how interior space is utilized near walls, peculiarities of residents (age, medical conditions, metal implants) & unrestricted access to areas where meters are located all argue for caution.**

[http://sagereports.com/smart-meter-rf/docs/Smart-Meter\\_Report.B-Tables.pdf](http://sagereports.com/smart-meter-rf/docs/Smart-Meter_Report.B-Tables.pdf)



# **International Appeal to UN:**

## **Scientists call to Protect Humans and Wildlife from Electromagnetic Fields and Wireless Technology**

- **Last month 212 distinguished scientists from 39 nations petitioned UN member states and WHO to adopt more protective exposure guidelines for non-ionizing EMF exposure**
- **IARC urged to move swiftly to reclassify RF-emitting wireless devices as Group 2A (“probably cancer-causing”) agents**
- **UN affiliated bodies were requested to: encourage precautionary measures; limit EMF exposures; and educate the public, especially children and pregnant women, about health risks.**

**“We have created something that is harming us, and it is getting out of control”.  
Martin Blank**



# ...and here in Canada

**Declaration: (56 international) Scientists call for Protection from Radiofrequency Radiation Exposure**

**We are scientists engaged in the study of electromagnetic fields (EMF) radiofrequency radiation (RFR) health and safety. We have serious concerns regarding Health Canada's Safety Code 6 Guideline.**

**July 2014**

**Declaration: Doctors<sup>†</sup> Call for Protection from Radiofrequency Radiation Exposure**

**Physicians Call for Health Canada to Provide:**

- i) Wireless safety standards ... more protective ... health of Canadians;**
- ii) Guidelines and resources to assist Canadian physicians in assessing and managing health problems related to microwave radiation.**

**(similar to: 2012, "Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses.")**


**<sup>†</sup> 55 in total**

**July 2014**

# Parliamentary Health Committee (HESA) Investigation into Safety Code 6 (2015)

*“ ... undertake comprehensive study ...  
Health Canada Safety Code 6 on human  
exposure to electromagnetic energy; ...  
invite relevant witnesses to appear; and  
... report findings to the House.”*

 Health Canada Santé Canada

Canada 

- **MPs involved: Hon. Hedy Fry (Vancouver Centre); Terrance Young (Oakville); Alex Atamenko (BC Southern Interior)**
- **Health Canada directed to publish full scientific monograph on missing 140 studies into chronic, low-dose, biological (non-thermal) effects. 30 Apr 2015**



May 2015

NEWS

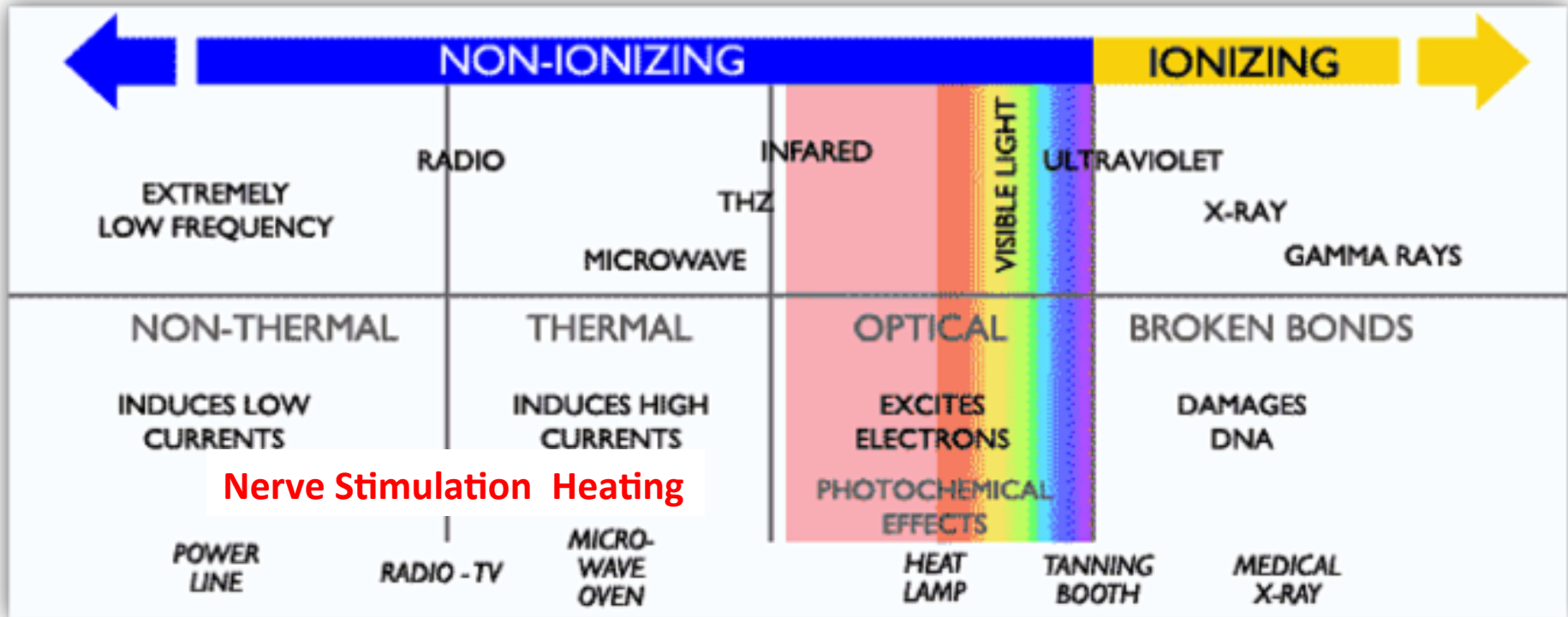
Scientists decry  
Canada's  
outdated Wi-Fi  
safety rules



- **Mount withering attack, warning microwave levels allowed in Canadian classrooms, residences and workplaces are “disaster to public health”**
- **Safety Code 6 (2015) – *Rationale* : “outdated, incomplete, invalid”;” simplistic, too much focus on dosimetry at expense of basic concepts in biology & health”**
- **Staff either ‘unwilling or not competent to make evaluation of current literature’**
- **Guidelines revised ‘behind closed doors’ using ill-defined, nonscientific weight of evidence approach; *Rationale* document not in public domain**
- **Guidelines’ major author, Frank McNamee, coauthored academic papers with scientists who have openly accepted payments from wireless industry.**

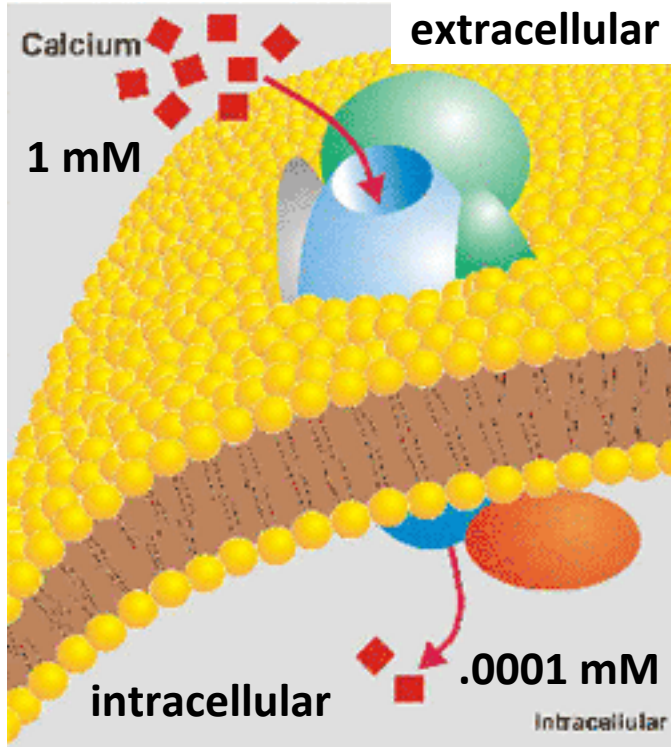
[http://www.cmaj.ca/site/earlyreleases/7may15\\_scientists-decry-canadas-outdated-wi-fi-safety-rules.xhtml](http://www.cmaj.ca/site/earlyreleases/7may15_scientists-decry-canadas-outdated-wi-fi-safety-rules.xhtml)

# Health Canada's View: EMR and Health Effects

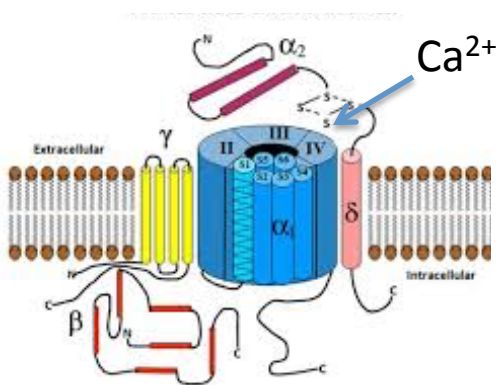


- “... other proposed adverse effects ... at levels below exposure limits in Safety Code 6 suffer from lack of evidence of causality, biological plausibility and reproducibility and do not provide credible foundation... for making science-based recommendations...”

# Voltage-gated Calcium Channels



- Membrane proteins in electrically excitable cells
- Channels open when cell excited by depolarizing stimulus
- $\text{Ca}^{2+}$  ions flow into cell from extracellular space
- This activates various calcium-dependent processes to trigger (or modulate) cellular responses
- Neurons release neurotransmitters or change functional properties (memory and learning)
- Muscle cells contract; pancreatic  $\beta$  cells release insulin (lower blood glucose)



# Late lessons from early warnings

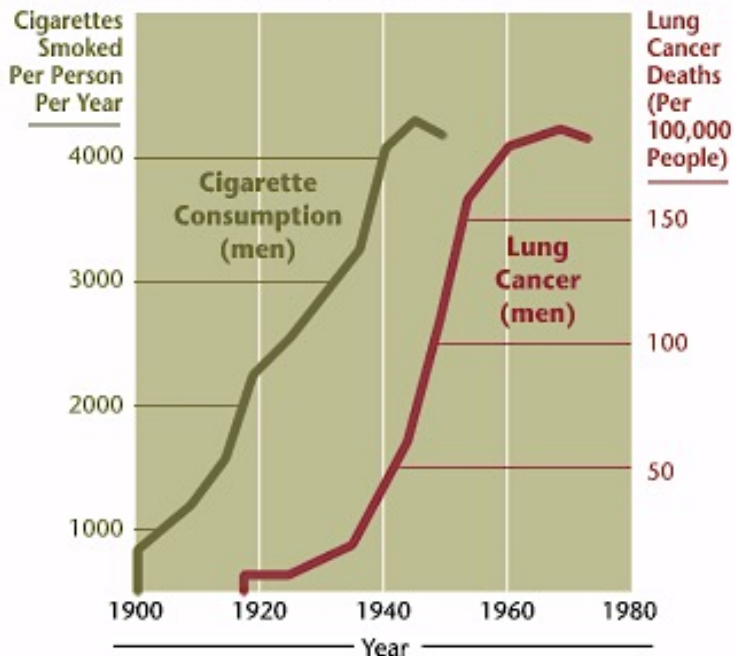
**“ Those who cannot remember the past are condemned to repeat it.”**      G. Santayana *The Life of Reason* (1905-06)

# Tobacco : Textbook Case of Governments Ignoring Precautionary Principle

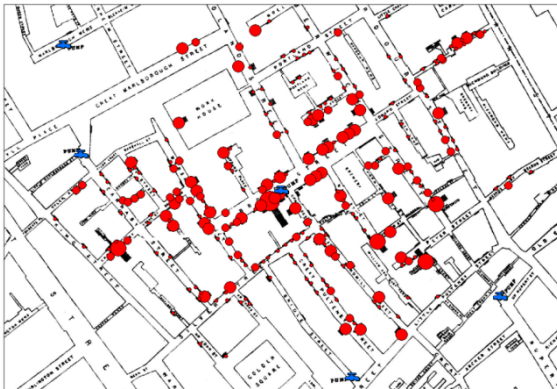


- Sir Richard Doll identified smoking as major cause of increase in lung cancer in late 1940's; upsurge in motor traffic during war was suspected cause.
- Tobacco industry demanded proof, including precise mode of action.
- Due to 20-yr lag, irrefutable population-based studies took decades to complete.
- Governments waited far too long before launching tobacco tax, advertising ban, smoke-free public buildings & anti-smoking ads.
- How many of ~ 100 million people killed by tobacco in 20th century might have been saved if action were taken earlier?
- Since smoking is addictive, even today many suffer from various tobacco-related, life-threatening diseases.
- **On average, 45 Canadians die each day of tobacco-related lung cancer.**

20-Year Lag Time Between Smoking and Lung Cancer



# London's Cholera Outbreak of 1854: Benefit in Heeding the Precautionary Principle



- Dr. John Snow mapped the location of deaths & found them to be clustered around the Broad Street Drinking Pump.
- His findings suggested that cholera is conveyed by water polluted with sewage.
- Royal College of Physicians rejected his thesis as 'untenable', believing disease caused by noxious vapors (*miasma*).
- As precautionary measure, Snow removed pump handle & outbreak came to an end.
- College's certainty proved incorrect.
- The link between human feces-polluted water and cholera in 1854 and Robert Koch's isolation of *Cholera vibrio* as the causative agent in 1883 took 30 years.
- Lengthy interval between a compelling association and conclusive causality is a common feature of scientific inquiry.



**Game changer: Precautionary principle  
in science-based risk management**

# Urgent Need for Paradigm Shift in Decision-making



Cost-Benefit Analysis



- We must shift away from asking, “**what level of harm is acceptable?**” to “**how can we prevent harm?**”
- Fundamental change in how we manage EMF regulation, from cost (risk)-benefit analysis to precautionary approach
- Sufficient scientific evidence on EMR-induced health risks (~7000 papers to date) to initiate this paradigm shift.

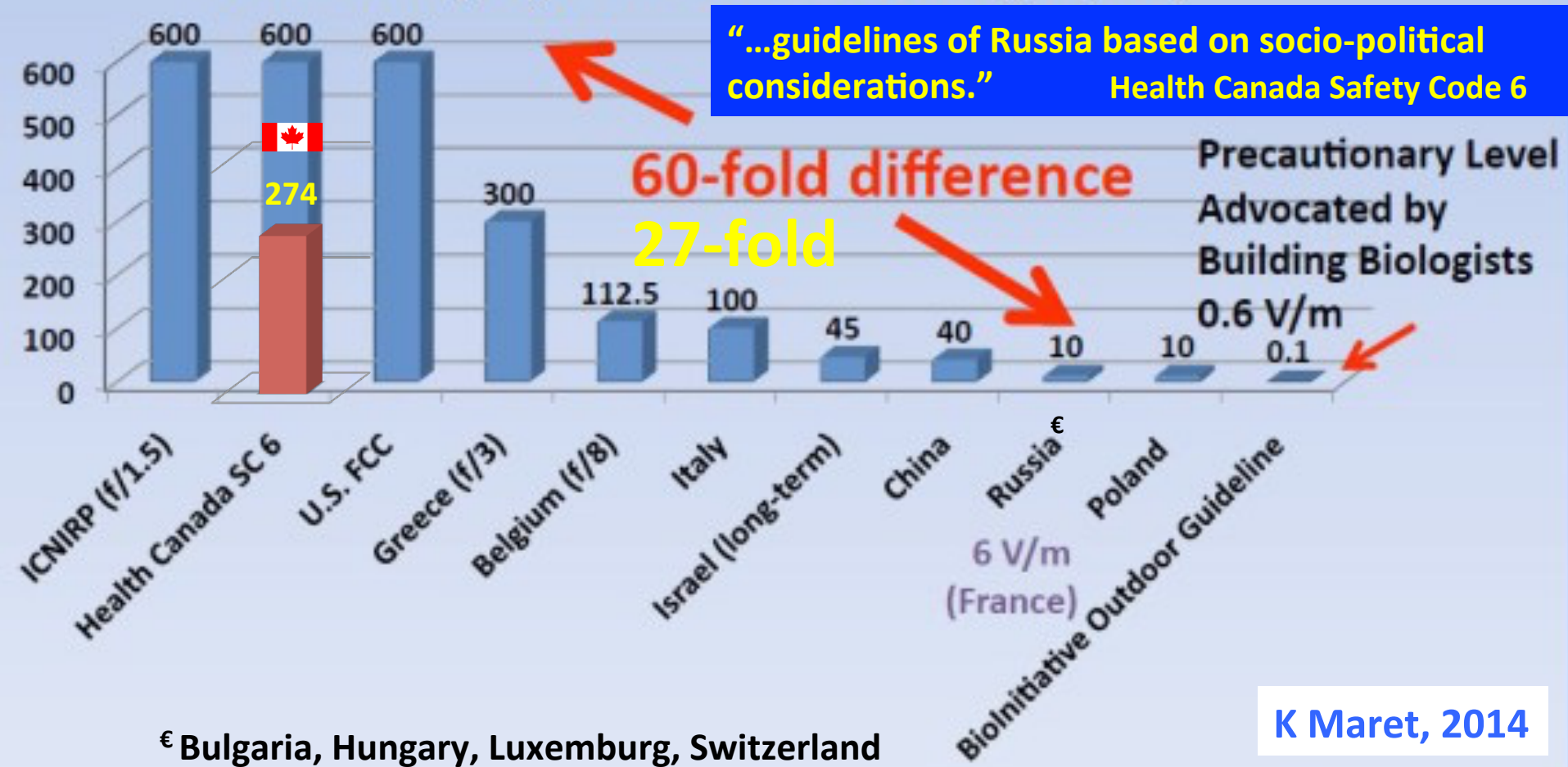


Too Little, Too Weak, Too Late

*The problem very often is that long before the science does come in, the harm has already been done.*  
*Michael Pollan*

# Exposure Limits at Smart Meter Radiofrequencies Vary Widely by Countries

Power Density Exposure Limits at 900 MHz ( $\mu\text{W}/\text{cm}^2$ )



- Bioinitiative Working Group 2012 calls for much lower limits:  $0.1 \mu\text{W}/\text{cm}^2$  (2700-fold difference).

Health Canada limits revised Mar 2015

**Concluding remarks**

# Why Living Is Hazardous to our Health

Radiation



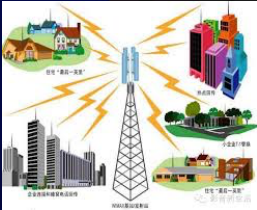
Electro-Smog

Cigarette smoke

Food



Oxygen



**Electro-Smog: New Class of Pollutants**

# The Best Way Forward

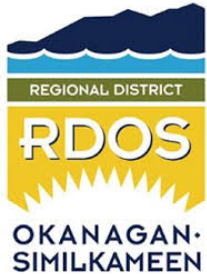


- We need to mobilize political will to counter the powerful economic forces driving nonstop roll-out of new wireless gadgets – public safety must trump innovation.
- There exists solid science-based evidence for the potential for non-thermal health impacts (latent cancers) from EMF-emitting devices.
- Given the enormity of the health risk, time to act decisively is now.
- Standard of evidence for judging the science should be precautionary; requiring conclusive evidence can delay avoidance action at early stage when health risks are still preventable.



# Steps in Call to Action<sup>£</sup>

- 1. Protect pregnant women and children (wireless-free learning/sleeping area).**
- 2. Strengthen guidelines and regulatory standards.**
- 3. Encourage manufacturers to develop safer technologies.**
- 4. Fully inform public of potential health risks from EM radiation and teach harm reduction strategies.**
- 5. Educate medical professionals about biological effects of EM energy and provide training on treatment of EHS patients.**
- 6. Provide government-funded training and arms-length research on EMF and health and mandate industry cooperation with researchers.**
- 7. Establish wireless-free public places ('white zones') for EHS subjects.**
- 8. Halt smart-meter grid installation until complexities of their EMF pulsed signals and attendant health impacts are better understood.**



# RDOS says 'No' to smart meters

**Director Tom Siddon's motion calls on province to stop installation of meters and for FortisBC to remove meters already installed on houses in Area D**

Penticton Herald

3 Jun 2015

**60 other municipal, city and band councils in BC have also passed motions for a moratorium on the mandatory installation of wireless "Smart" Meters.**



# Advice for Reducing Personal Risk from EMF Exposures

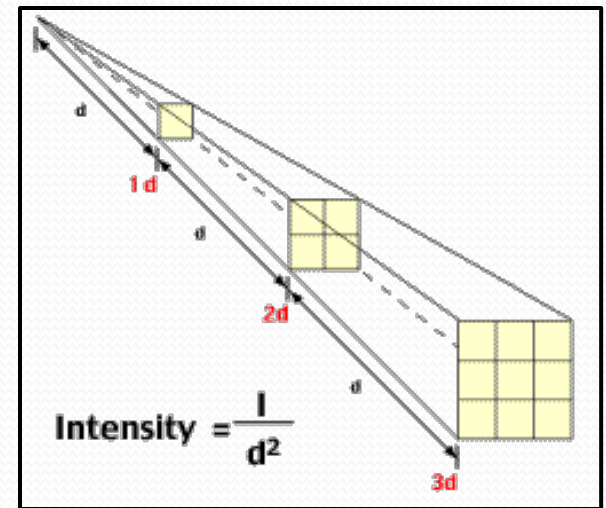


Practice prudent avoidance by following two basic rules:

1. Minimize your use of EMF-producing technologies
2. Maximize your distance from these technologies when in use.

# Importance of Maximizing Distance from WiFi-emitting Devices

Level in contact with device = 90,000  
Level at 3 m (10 ft) = 2,000  
Level at 30 m (100 ft) = 1  
(units in  $\mu\text{W}/\text{m}^2$ )



## INVERSE SQUARE LAW

$$\text{Radiation Level} = \frac{1}{(\text{DISTANCE})^2}$$

## Understanding The Inverse Square Law

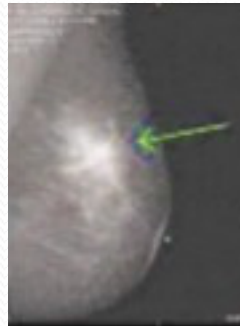
METRES	1	2	3	4	5	6	7	8	9	10
POWER	1	1/4	1/9	1/16	1/25	1/36	1/49	1/64	1/81	1/100
%	100%	25%	11%	6%	4%	3%	2%	2%	1%	1%

# Practical Steps to Reducing EMR Risk



1. Create safe (WiFi-free) learning and sleeping environment for our kids.
- Many schools have 'industrial grade' WiFi systems with 'killer coverage'.
  - ~13,000 exposure hrs by grad day
  - No scientific studies on long-term biological effects of WiFi on children
  - Easy solution: 'hard-wire' computers to internet: safer, faster, more secure.

# Practical Steps to Reducing EMR Risk



2. Bras aren't for cell phones.

3. Neither are pockets. Carry phones in handbags, briefcases or backpacks.

4. Airplane mode isn't only for airplanes.

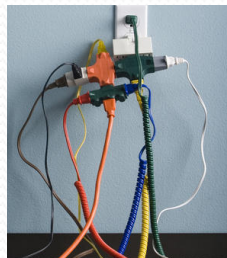
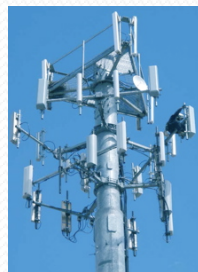
5. Use 'air-tube' headset with cell phone.

6. Laptop tablets aren't for laps. Keep  $\geq 20$  cm from body. In China, pregnant women wear protective apron.



M Blank *Overpowered*, p. 196-210.  
Seven Stories Press, New York 2014

# Practical Steps to Reducing EMR Risk



7. Reduce concurrent exposures (adverse health effects unknown).
8. Do not live near high-voltage power lines.
9. Stay away from transformers.
10. Live as far away from cell phone towers as possible.
11. Do not use electric blankets or heated waterbeds.
12. Run extension cords clear and away.

# Practical Steps to Reducing EMR Risk



13. Use battery, not electric, alarm clocks.

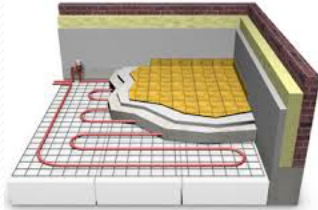
14. Use energy-efficient appliances.

15. Do not use dimmers or three-way switches.

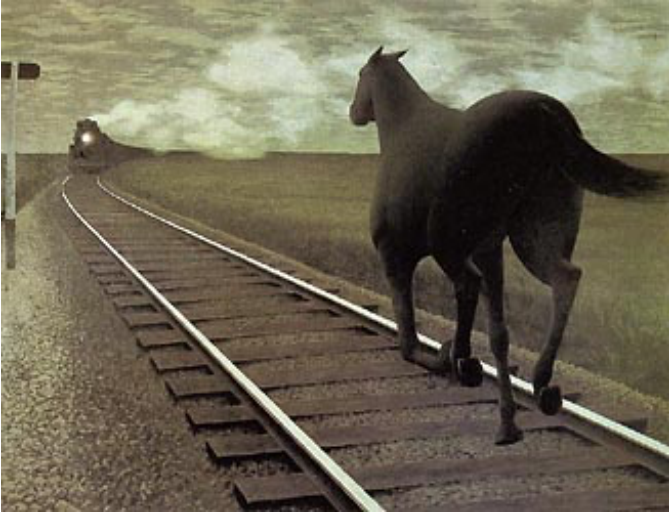
16. Do not use radiant electrical floor heating.

17. If use microwave oven, leave kitchen when on and service regularly.

18. Place high EMF appliances against outer walls.



# Status Quo is Not an Option



Horse and Train, 1954 Colville

**“The world is not dangerous because of those who do harm but because of those who look at it without doing anything.**

**Albert Einstein**

***'If there is even a reasonable possibility that cell phone radiation is carcinogenic, the time for action ... is upon us. Even though the financial and social cost of restricting such devices would be significant, those costs pale in comparison to the cost in human lives from doing nothing.... If the probability of carcinogenicity is low, but the magnitude of the potential harm is high, good public policy dictates that the risk should not be ignored.'***

**Supreme Court Judge FH Weisberg, 8 Aug 2014**

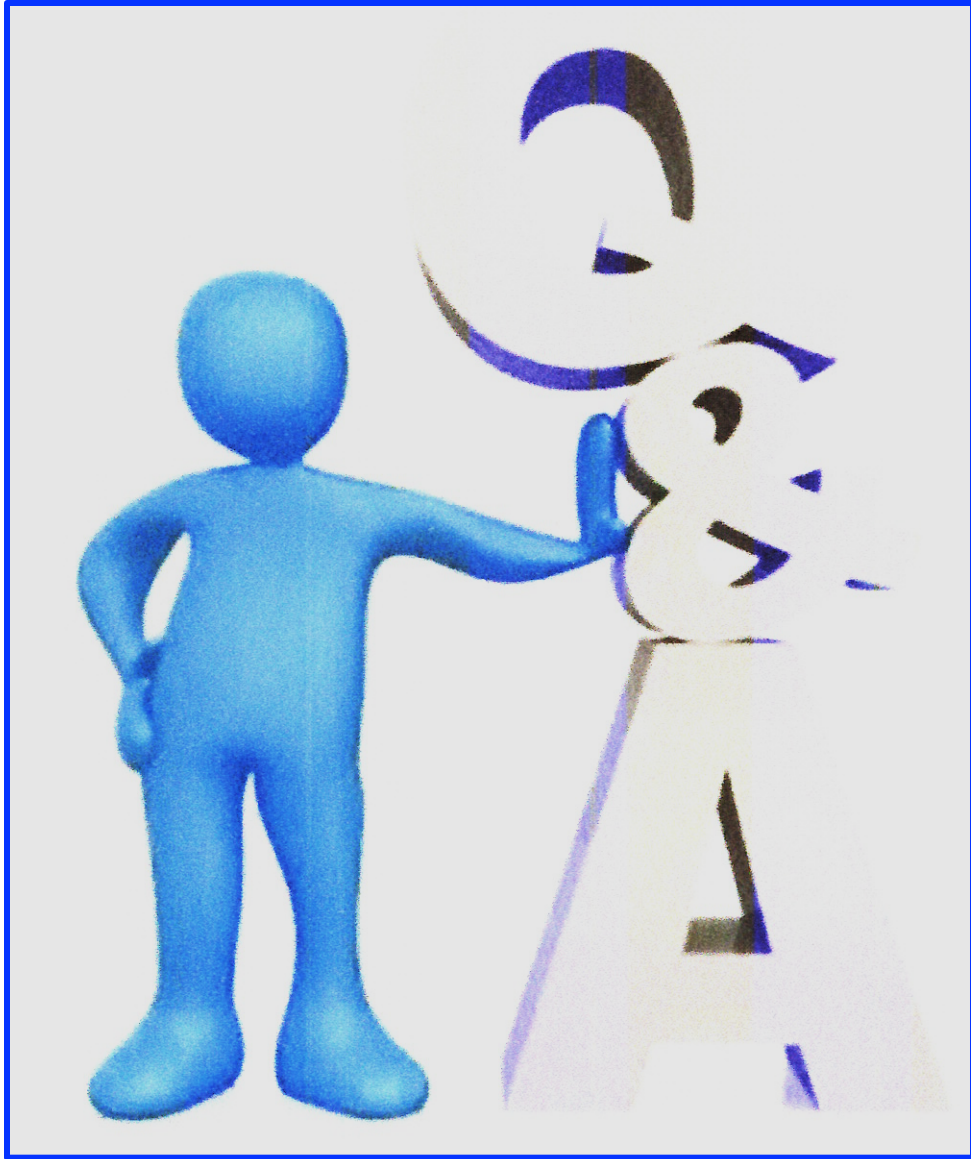
# Children and EMF



*We hold the future in our hands  
and it is our children.*

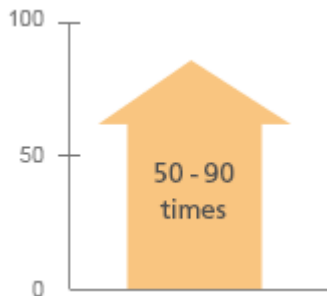
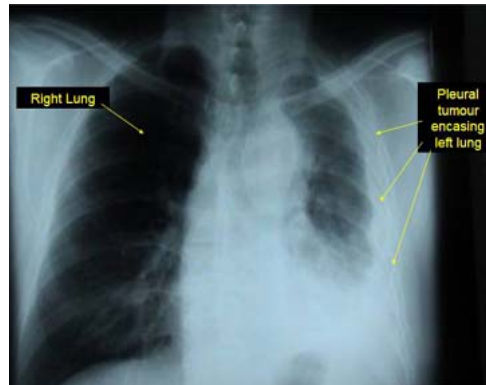
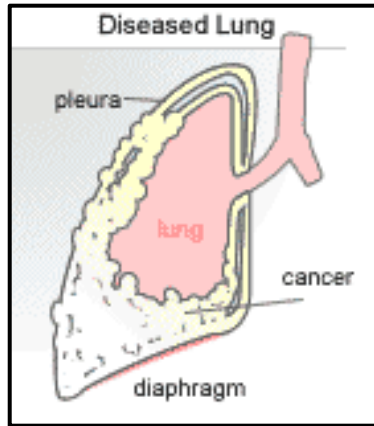
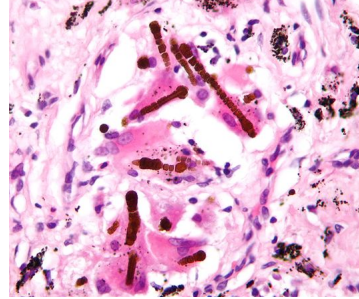
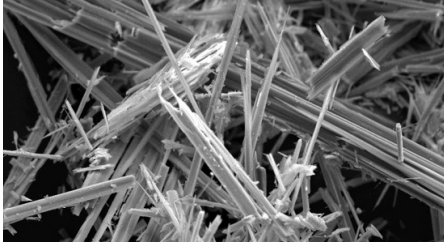






**Parking Lot: Follow-up for any unanswered questions**

# Asbestos Exposure: Industry & Government Downplay Health Risk

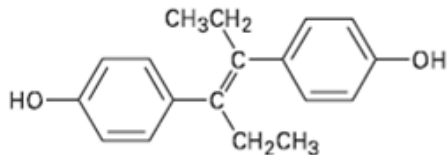


↑ lung cancer risk if person  
smokes & exposed to asbestos



- Gained widespread use as fire-retardant & insulation material
- Reported to cause serious ailments as early as 1898 (Lucy Deane, London)
- Despite early warnings, industry continued production, failed to protect workers & insisted no substitute for it.
- Not until 1998 was it banned totally in UK
- Former workers developed debilitating diseases: asbestosis, mesothelioma & lung cancer.
- Long latency period between asbestos exposure & disease appearance: asbestosis (10 yrs); lung cancer (15-25 yrs)
- Smoking or second-hand smoke, together with asbestos exposure, greatly increases risk of lung cancer.
- Mechanism of action still uncertain.

# Diethylstilbestrol: World's First Drug Disaster

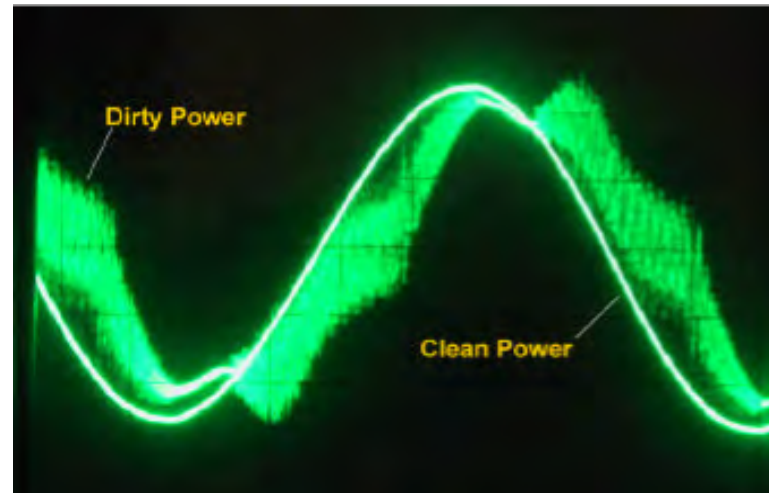


- DES: synthetic estrogen developed in late 1930's to prevent miscarriage.
- First danger signs: breast cancer link in animal studies & severe GI issues at clinical trials stage
- Yet prescribed to millions of pregnant women for 3 decades in US & 4.5 decades elsewhere
- Transplacental carcinogen, causing abnormal reproductive organs, infertility & cancer in offspring of women exposed during pregnancy
- Despite 20,000 articles on DES, mechanism of action still uncertain
- No sign of toxicity in newborn offspring
- Timing of dose, not amount, determines toxicity.
- *DES story should remind us that 'we will never know the long-term safety of a product until long term safety of the product is proven.'* (Elizabeth Watkins)

# Switching Mode Power Supply: 'Dirty Electricity'



Label on side of  
smart meter



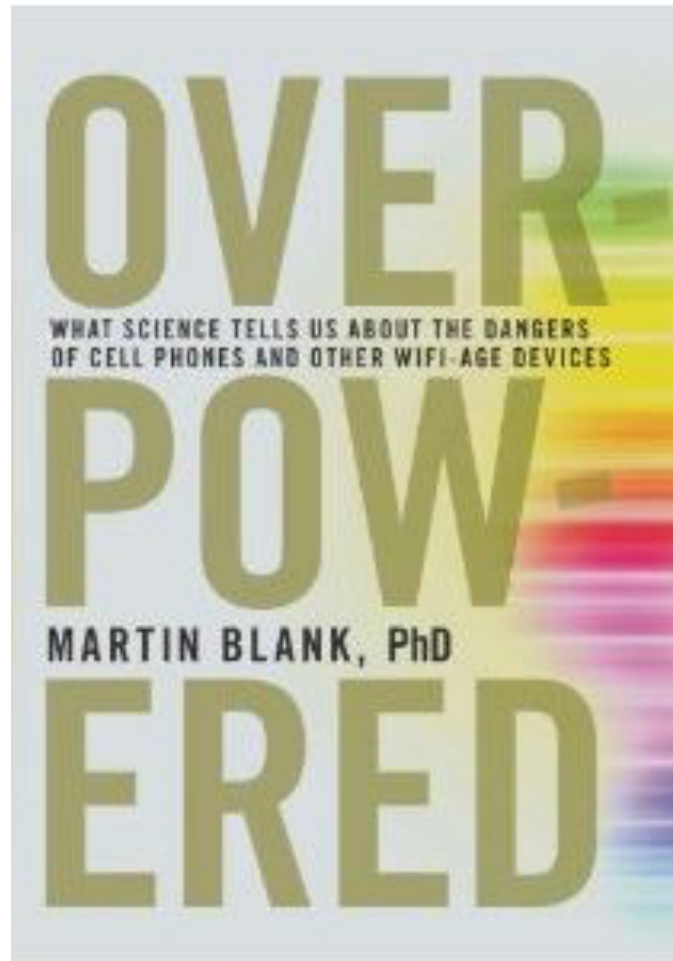
- 'Step-down' from 120 v (AC) to 2-10 v (DC); run digital electronics to record usage data; both wireless & wired options
- Emits high freq. transients as sharp mSec spikes (4kHz – 60KHz); constant (24/7)
- May contribute to reported negative health effects after meter installation.

# Wingspread Statement: Precautionary Principle



Defined at Wingspread Conference,  
Johnson Foundation, Racine,  
Wisconsin, 15 January 1998.

- "When an activity raises threats of harm to human health..., precautionary steps should be taken even if some cause and effect relationships are not fully established scientifically.
- ... proponent of an activity, rather than the public, should bear burden of proof.
- Process of applying precautionary principle must be open, informed and democratic and must include potentially affected parties.
- It must also involve analysis of full range of alternatives, including no action."



***Overpowered* Martin Blank**  
**Seven Stories Press New York 2014**

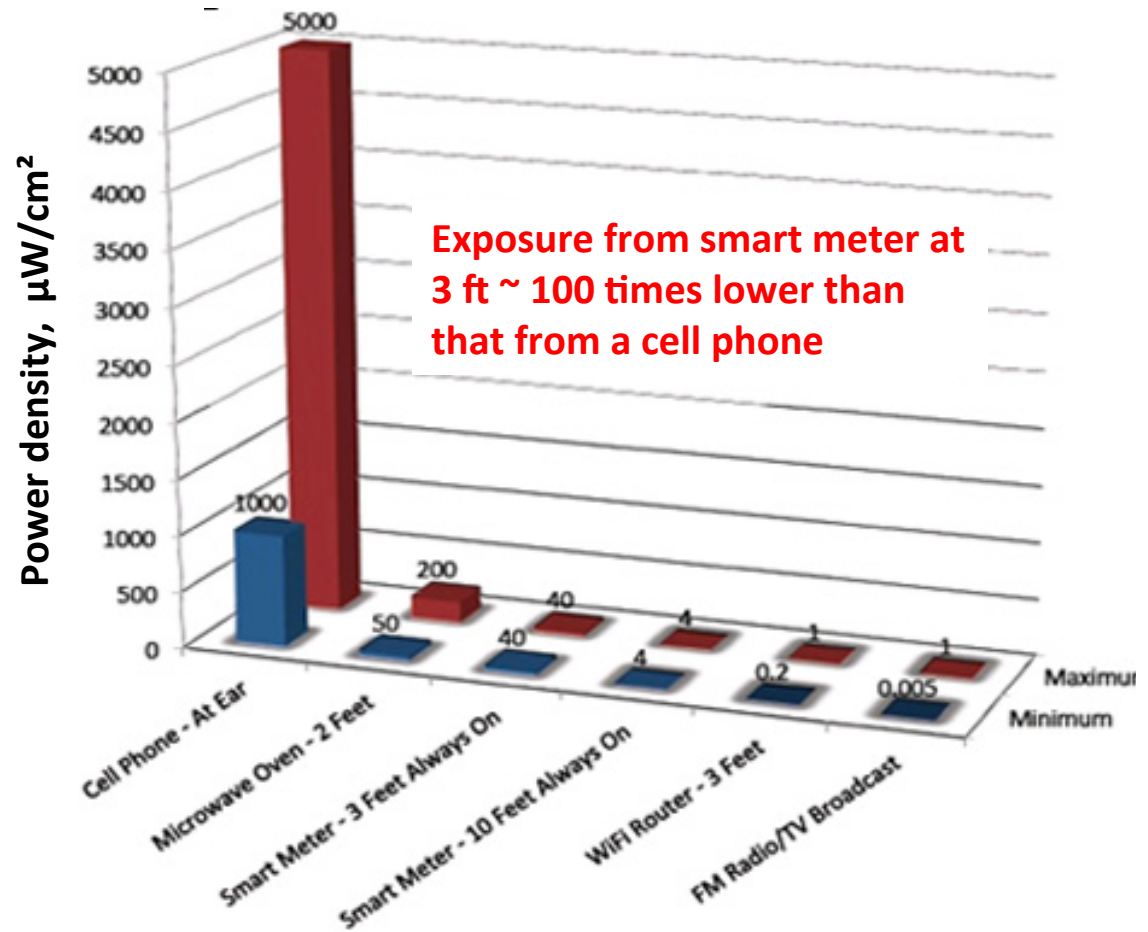
# A Cautionary Note

- **WHO and IARC Reports, however august, were not sent out for blind scientific peer-review, reducing their level of scrutiny and credibility.**
- **The review panels contain overlap in membership so their deliberations should not be taken as independent.**
- **Authors of policy-related documents should not be the same people as those who write the cited scientific papers.**
- **The statutory status of these bodies does not mean they are infallible.**
- **Recent experiences in other high profile areas (e.g., climate change) suggest that these bodies often serve a political process.**
- **The potential impact of adverse health effects associated with ELF EMF exposures related to electricity supply is systematically downplayed in these 'official' reports.**



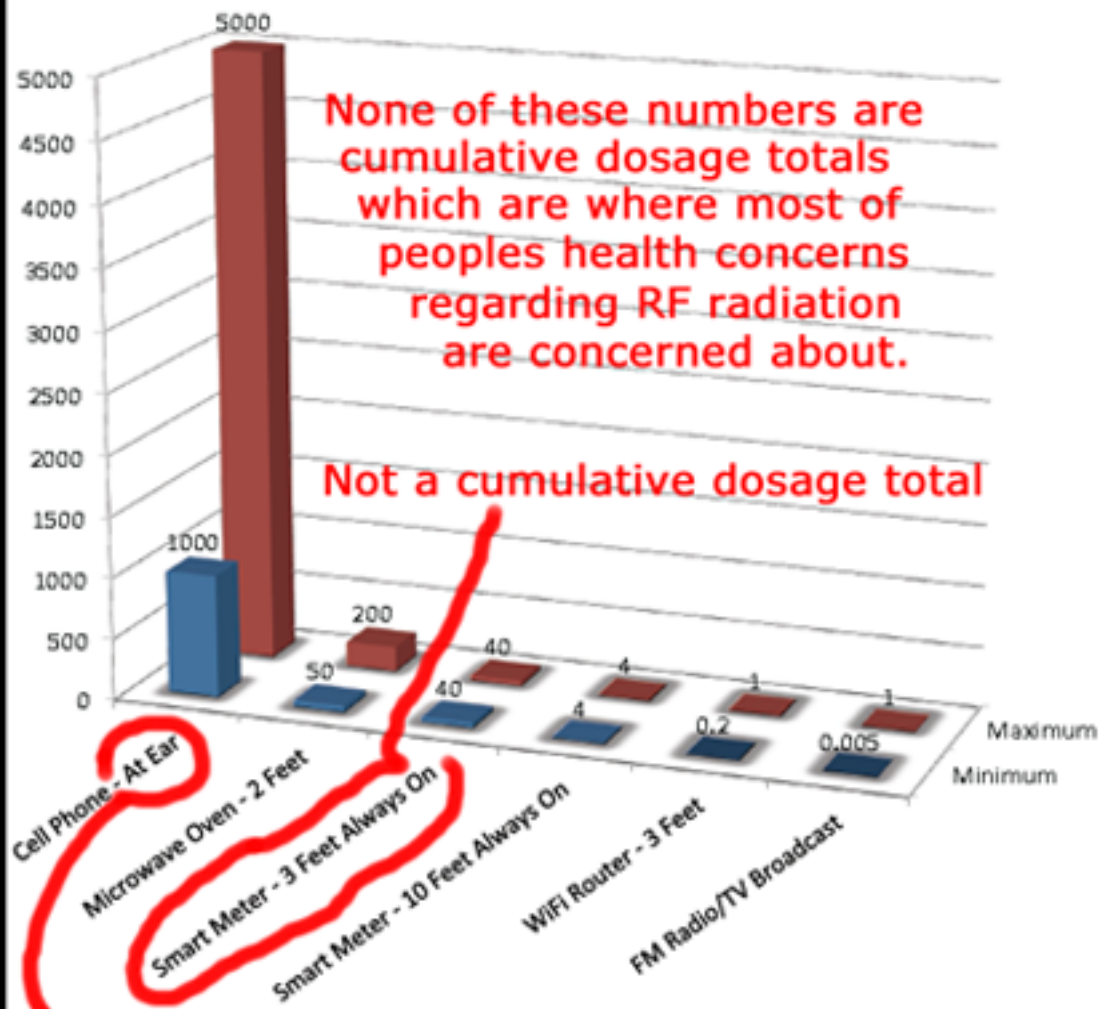
# Instant Power Density Levels of Common RF Devices

**'Go -to' figure for utility companies**



Source: Electric Power Research Institute (industry advocate group)

- Assumes distances in far-field, where power density falls off as square of distance from source (inverse square law)
- Smart meter power density scaled to obtain output for 50% duty cycle ('on' 50% of time)
- Smart meter RF pulses are 'time-averaged' over 30 min, instead of providing 'peak power'.

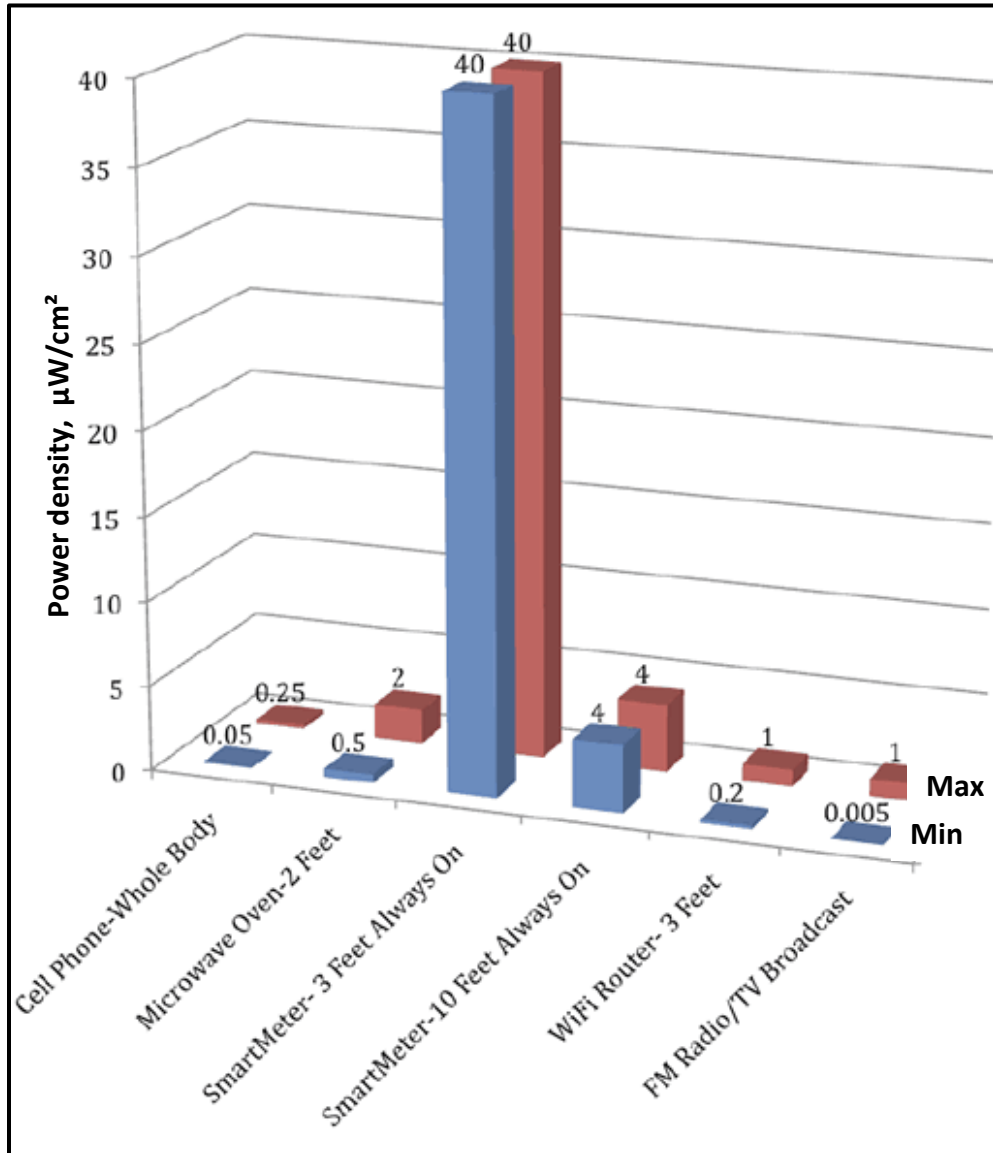


None of these numbers are cumulative dosage totals which are where most of peoples health concerns regarding RF radiation are concerned about.

Not a cumulative dosage total

Dose for an ear

# Comparison of Power Density Levels to Whole Body from Common RF Devices Over Time



Corrected for 2 critical errors in CCST report:

- failure to factor in duty cycles of cell phones & microwave ovens
- failure to compare using same units (average whole body exposure)

Estimated effect of these corrections:

- at 3 ft, smart meter produces 53-160 times cumulative whole body exposure of cell phone.

Exposure levels still differ by 100 times but now higher, rather than lower, for smart meter compared to cell phone. **10,000-fold shift**

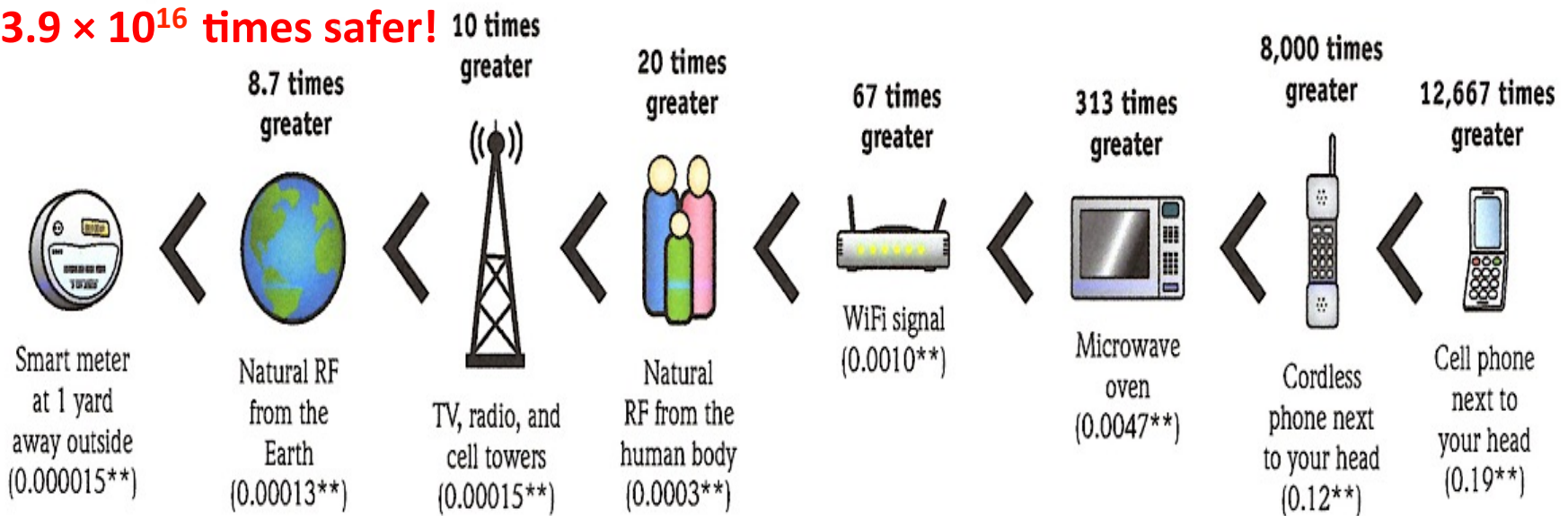
From: D. Hirsch (nuclear policy expert; UCLA lecturer; President, Committee to Bridge the Gap)

<http://www.ccst.us/projects/smart2/documents/letter8hirsch.pdfsch>

# Is smart meter RF exposure safe? Yes.

RF exposures from smart meters are much lower than other RF sources\*

**3.9 × 10<sup>16</sup> times safer!**



\* Based on the FCC average exposure standard which averages exposure over 30 minutes of usage (47CFR1.1310 averaging)

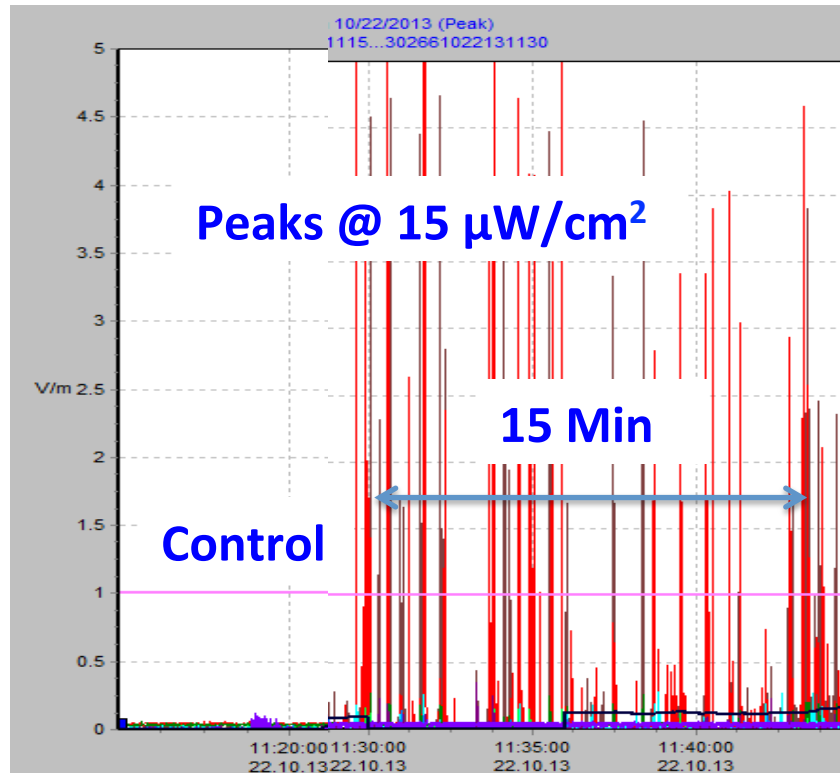
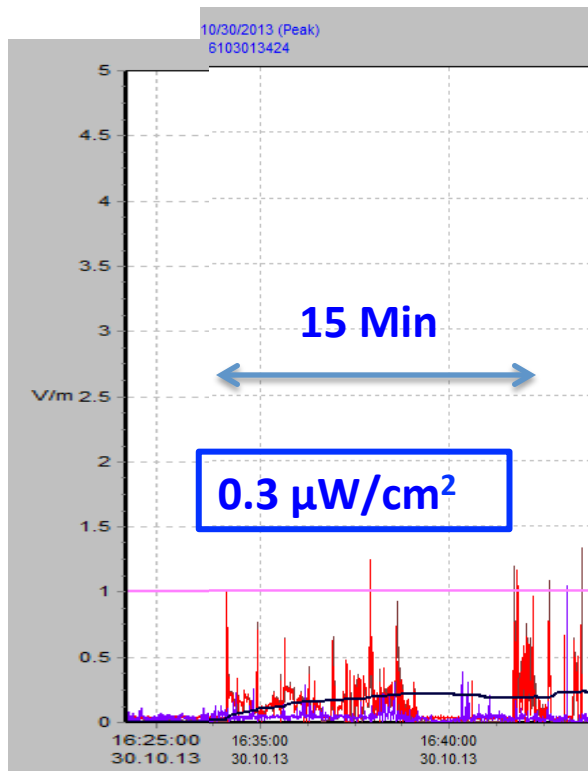
\*\* Measured in milliwatts per square centimeter (mW/cm<sup>2</sup>)

“... This combination of placement and infrequent operation means that you would need to be within one foot of 7,000 smart meters all communicating at the same time to reach the FCC exposure limit.”

From: YP Shkolnikov

[http://www.cmpco.com/MediaLibrary/3/6/Content%20Management/YourAccount/PDFs%20and%20Docs/RF\\_FactSheet\\_web.pdf](http://www.cmpco.com/MediaLibrary/3/6/Content%20Management/YourAccount/PDFs%20and%20Docs/RF_FactSheet_web.pdf)

# iPhone in use vs. 2.5 m from 5 Smart Meters



- Whole body exposure for both iPhone and 5 smart meters
- ~ 8000 pulses/day; actual rate depends on duty cycle and other meters close by
- Short burst pulsed EMFs new to living systems, never tested prior to deployment.

Source: K Maret: Address to Commonwealth Club, San Francisco, 28 Jan 2014

# **Plausible Mechanism Underlying Bio-effects from Pulsed RF Radiation**

# Mechanisms Underlying Health Impacts of EMF Radiation



Low Level, Non-thermal  
Electromagnetic Fields

K. Maret: Commonwealth Club  
San Francisco, 28 Jan 2014

Biological Windows Activated  
at Specific Amplitude & Frequency

Free radicals Formation  
--> Oxidative Stress &  
Membrane Lipid Damage

Release of Calcium Ions  
in Cell membranes  
May make Membranes Leak

Microwaves absorbed by  
Magnetite granules in Brain  
--> Local Microheating Effects

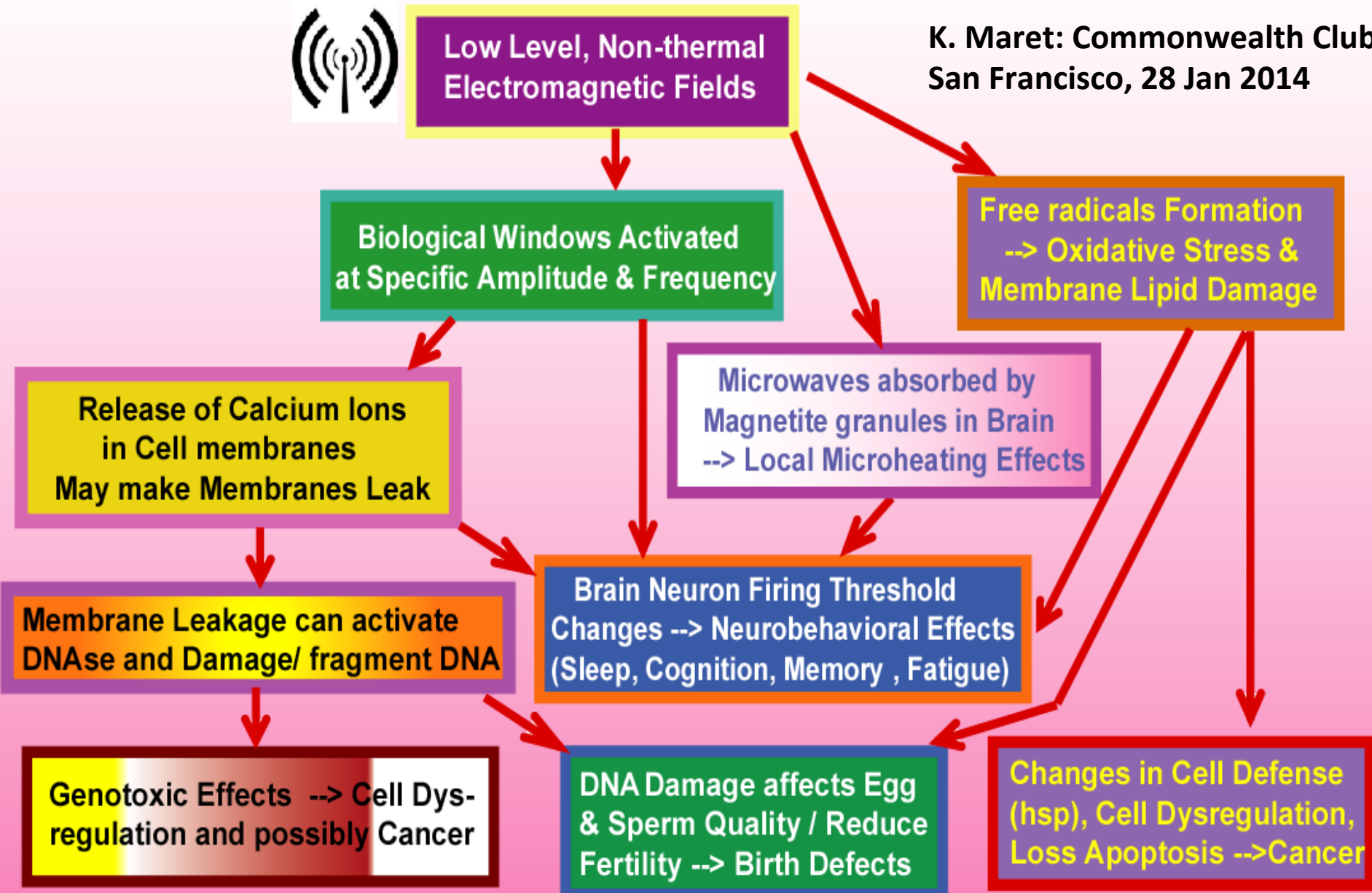
Membrane Leakage can activate  
DNAse and Damage/ fragment DNA

Brain Neuron Firing Threshold  
Changes --> Neurobehavioral Effects  
(Sleep, Cognition, Memory , Fatigue)

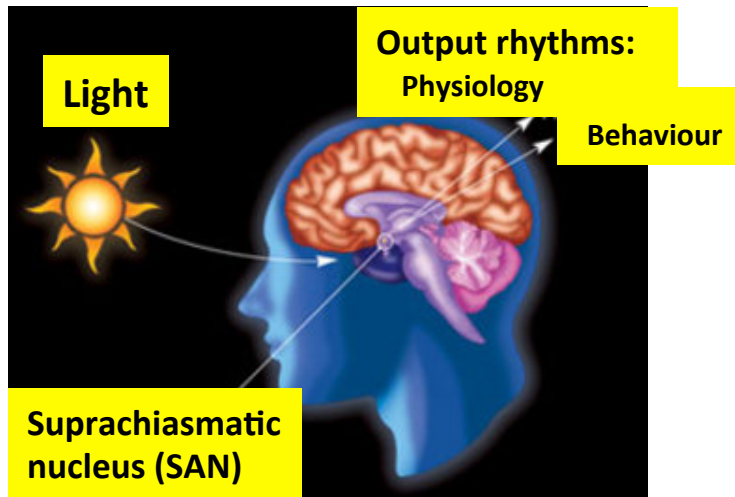
Genotoxic Effects --> Cell Dys-  
regulation and possibly Cancer

DNA Damage affects Egg  
& Sperm Quality / Reduce  
Fertility --> Birth Defects

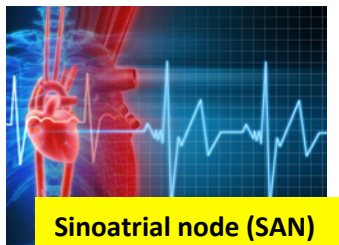
Changes in Cell Defense  
(hsp), Cell Dysregulation,  
Loss Apoptosis --> Cancer



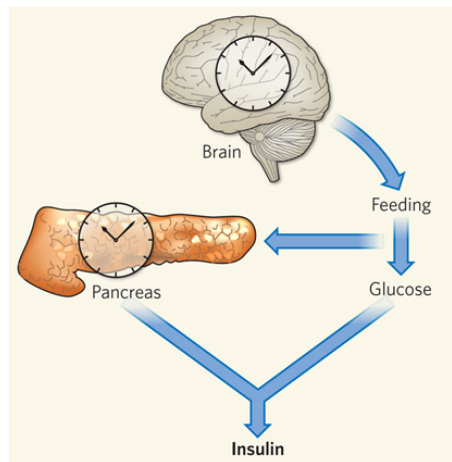
# Specialized Cellular Clocks: Pacemaker Cells



Circadian rhythms



Heartbeat regulator



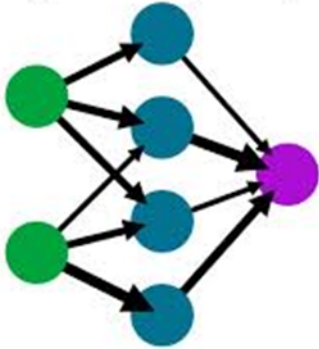
Metabolic co-regulating clocks in brain & pancreas

- Humans are **biochemically dynamic**
- **Constantly subjected to time-varying conditions** from **extrinsic forces & intrinsic rhythms** from **specialized circadian 'clocks'**
- **Clocks** reside in our **brain, heart & pancreas** & **regulate critical functions: body temperature, hormone production, heart rate, blood pressure & digestive metabolism**
- Comprised of **populations of biologically oscillating (pacemaker) cells** with distributed **natural EM frequencies**
- **Cells act co-operatively** to pull one another into **synchrony** & generate **electrical rhythms**
- Their **actions** are dependent upon **exquisitely timed cues** from **environment forces** at **vanishing small levels**.



# Unifying Hypothesis: Pulsed RF EMF as Disrupter of Synchronized Neural Activity

A simple neural network  
input layer   hidden layer   output layer



Neural network

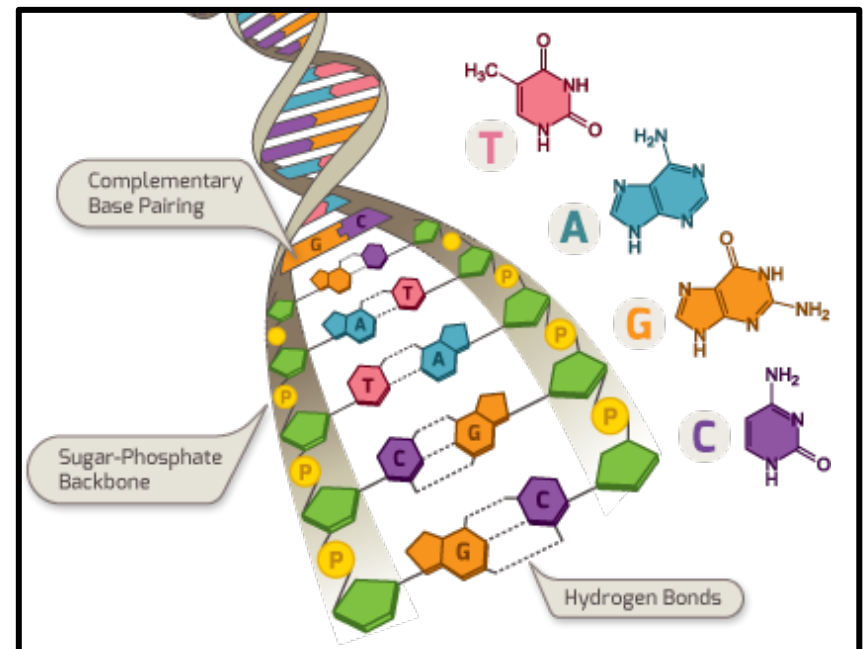
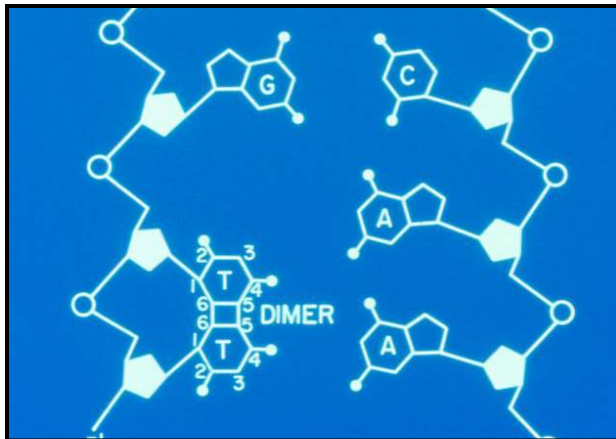
- **Synchronized biological oscillations** in pacemaker cells can be **disrupted** by artificial, exogenous signals, resulting in **de-synchronization** of neural activity.
- **Weak field interactions** of pulsed RF radiation & ELF-modulated RF radiation may **disrupt electrical rhythms** by which circadian clocks regulate critical functions in neural, cardiac & digestive systems.
- **Increasing reports** from electro-sensitive persons suggest **pulsed RF-emitting devices** may have **adverse health effects**.
- **The emerging smart meter/grid infrastructure** represents the **largest commercial saturation** of living space of **pulsed RF radiation** yet rolled out by the **wireless industry**.

# Natural Damage to Human Cell Genome<sup>¶</sup>

Class	Induction Rate (no./hr)	Repair Rate (no./hr)
Purine (A,G) loss	580	
Pyrimidine (C,T) loss	29	
Deamination of cytosine	8	
Single-strand breaks	2,300	20,000
O <sup>6</sup> - Methylguanine	130	50,000
Pyrimidine dimers <sup>§</sup>	50,000	50,000

<sup>¶</sup> $3.1 \times 10^9$  base pairs in human genome

<sup>§</sup>Dimer induction rate for Austin, Texas at midday



**Non-ionizing radiation  
( cell phones )**

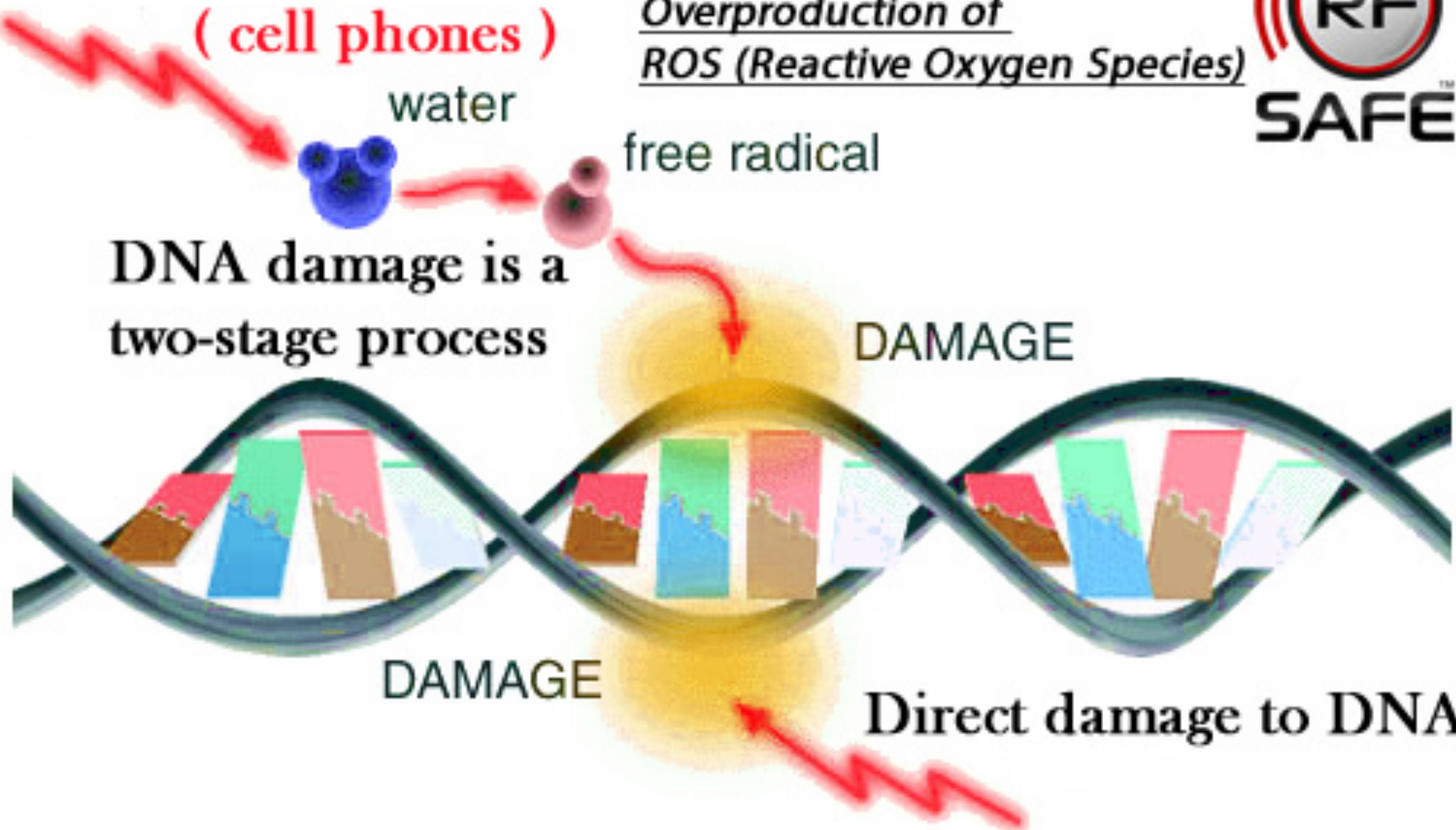
**DNA and the Microwave Effect**  
Overproduction of  
ROS (Reactive Oxygen Species)



water

free radical

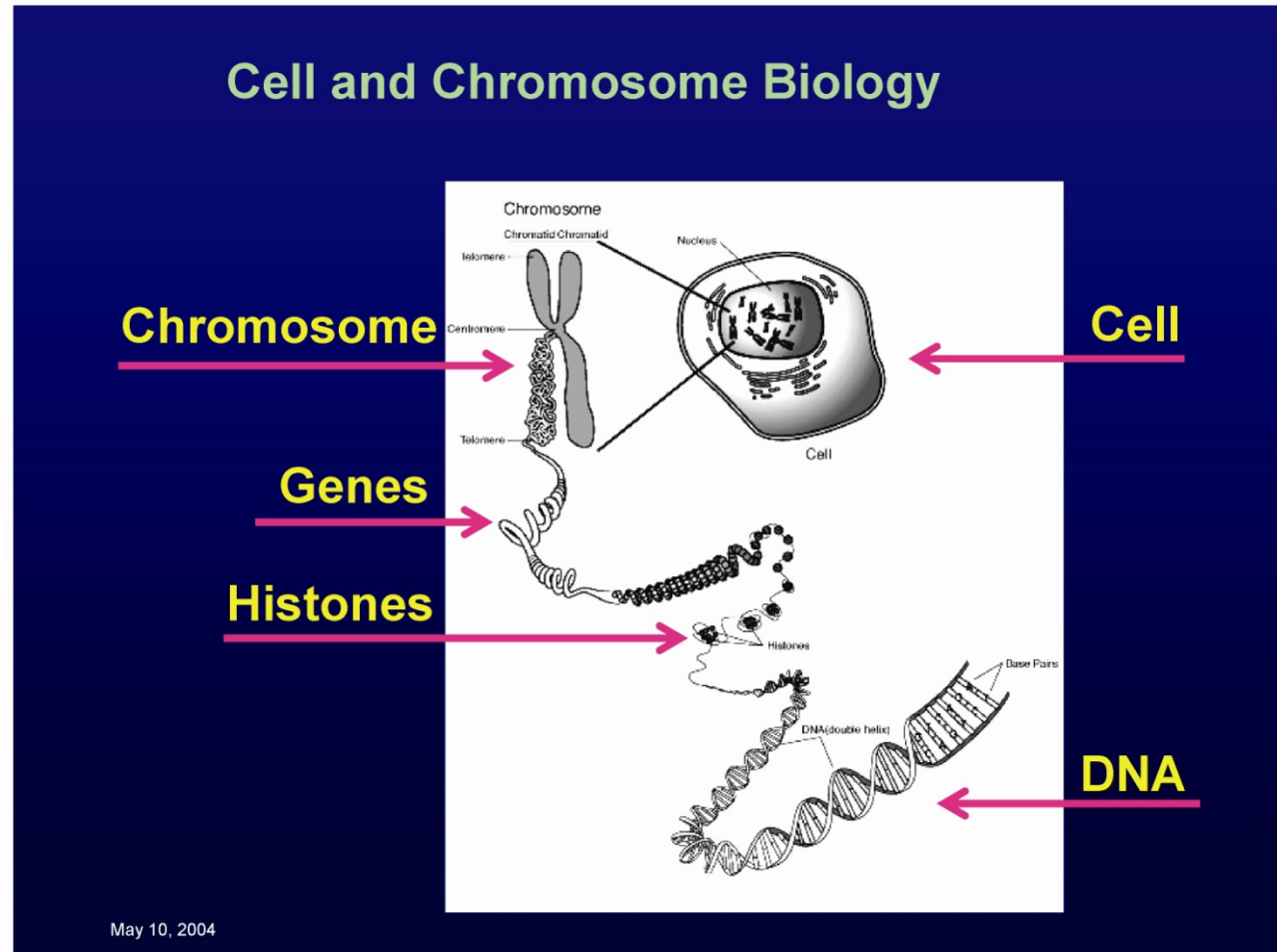
**DNA damage is a  
two-stage process**



**Direct damage to DNA**

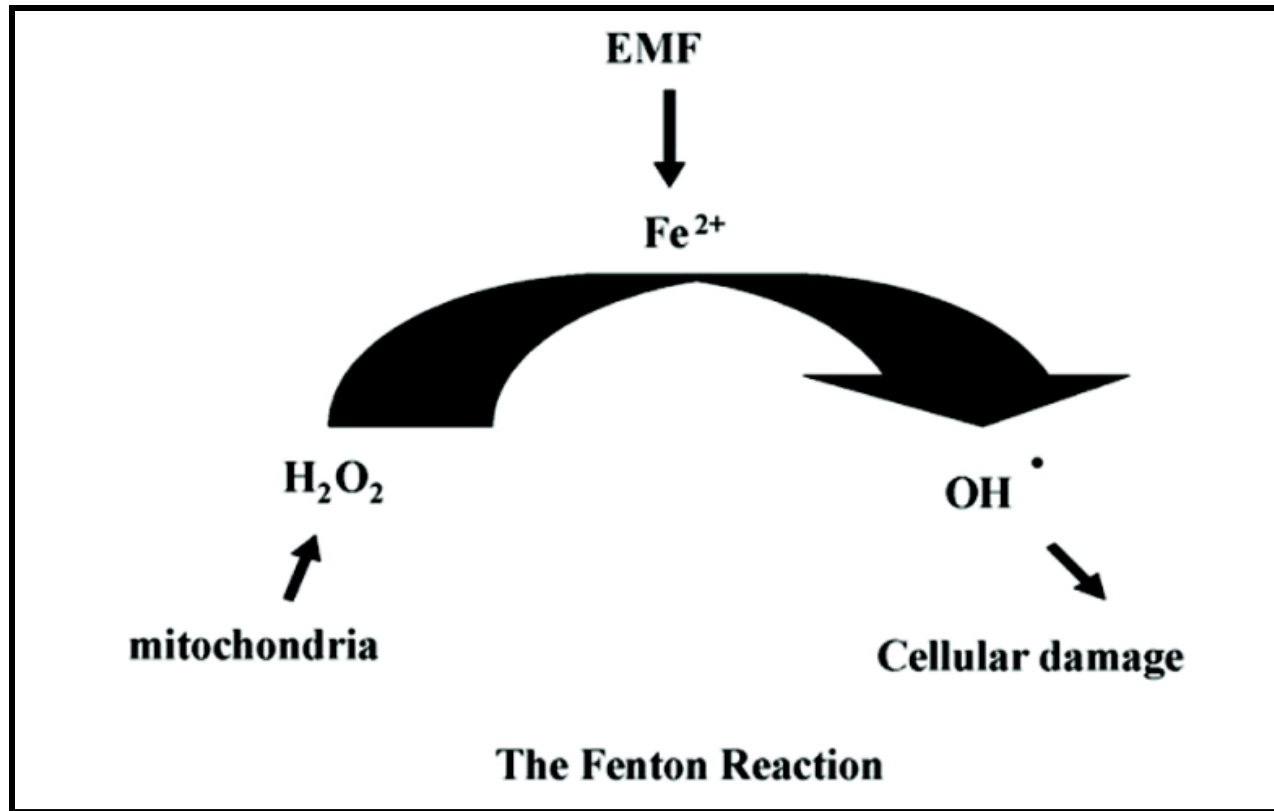
**Ionizing radiation ( x-rays )**

# Anatomy of the Book of Life



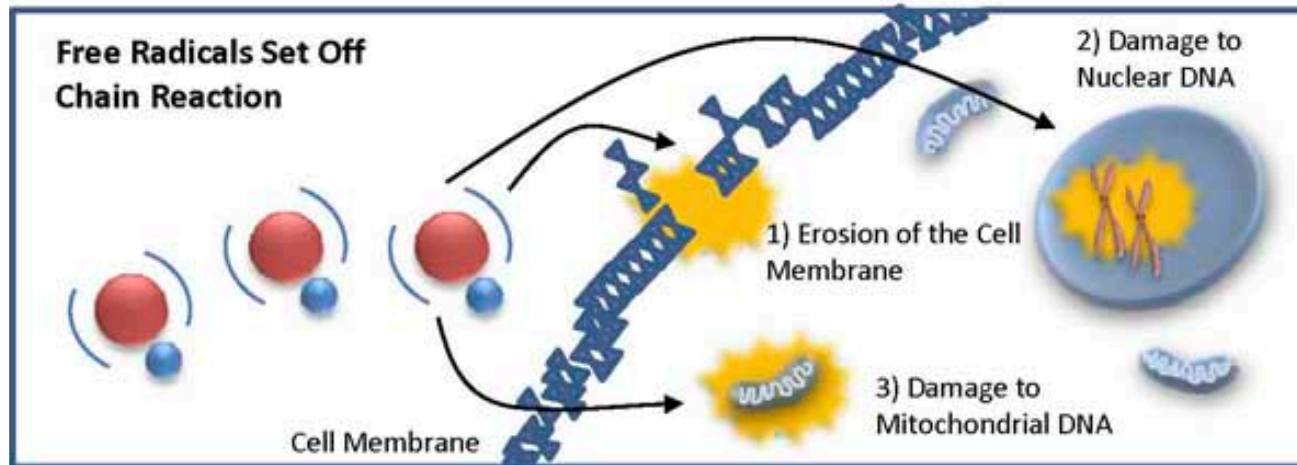
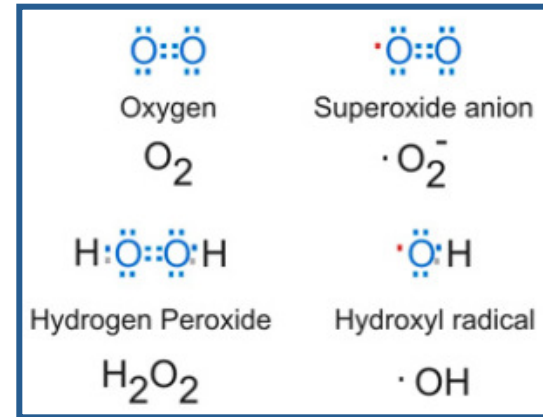
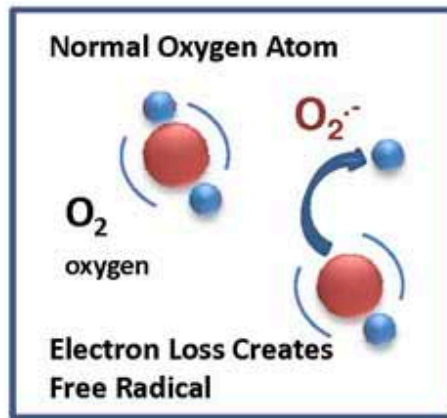
- **3.16 billion DNA base pairs** containing **20,000 protein-encoding genes (750 MB)** (gene: stretch of DNA that forms most **basic unit of heredity**; avg. size: **3,000 bps**)
- If unwound & tied together, **DNA strands in 23 chromosome pairs** would **stretch** more than **5 ft** but be only **50 trillionth of inch** wide)

# Plausible Mechanism for EMF-Induced DNA Strand Breaks



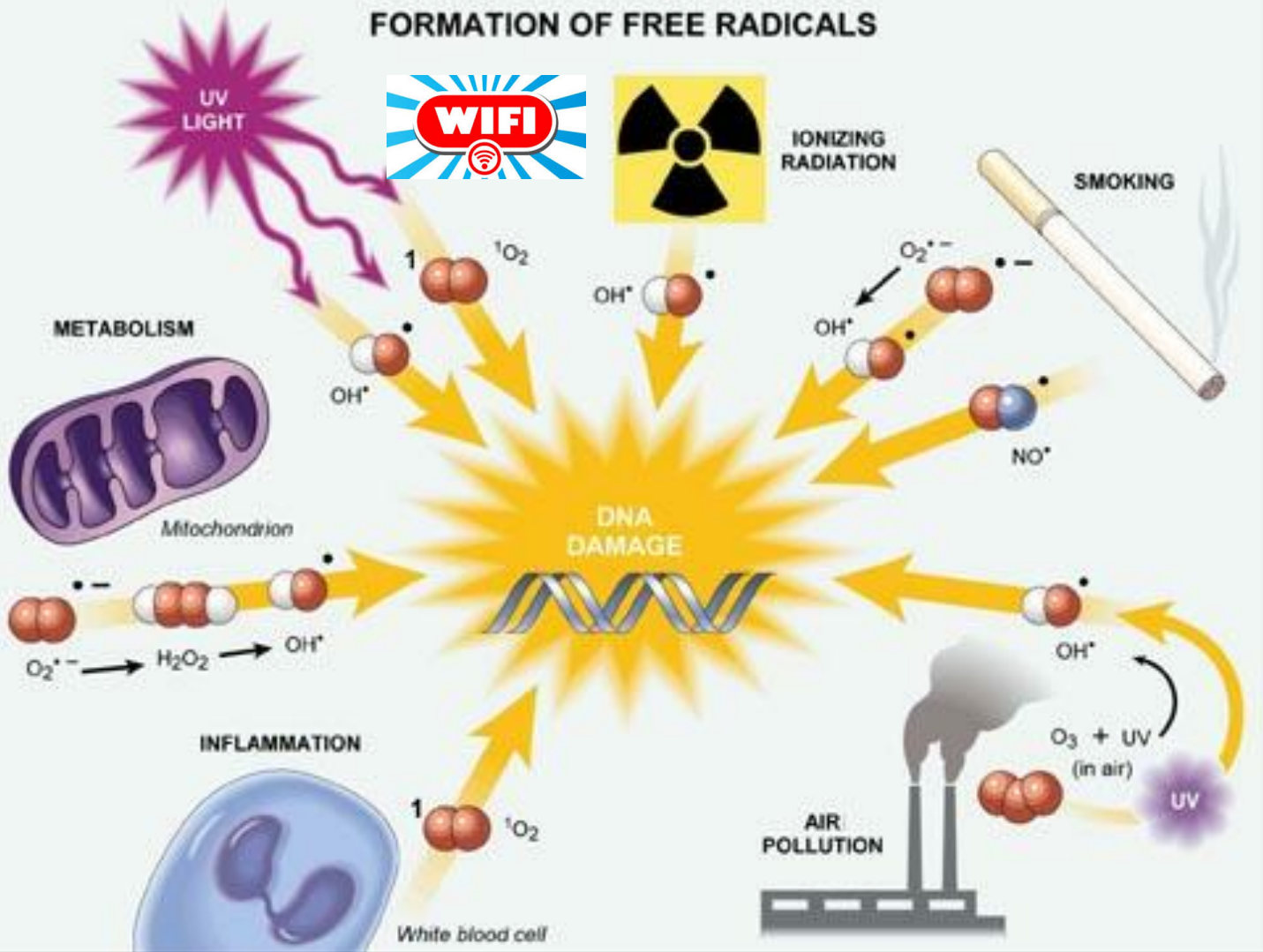
- DNA may be damaged by free radicals formed inside cells – Fenton reaction
- Reaction catalyzed by iron in which hydrogen peroxide, product of oxidative respiration in the mitochondria, is converted into hydroxyl free radicals .

# Free Radical Damage



- Sequential reduction of oxygen via addition of electrons leads to formation of various ROS.
- Free radicals erode cell membranes and damage nuclear & mitochondrial DNA.
- Many diseases linked to oxidative stress: cancer, diabetes, cardiovascular & neurodegenerative diseases, as well as the aging process.

## FORMATION OF FREE RADICALS

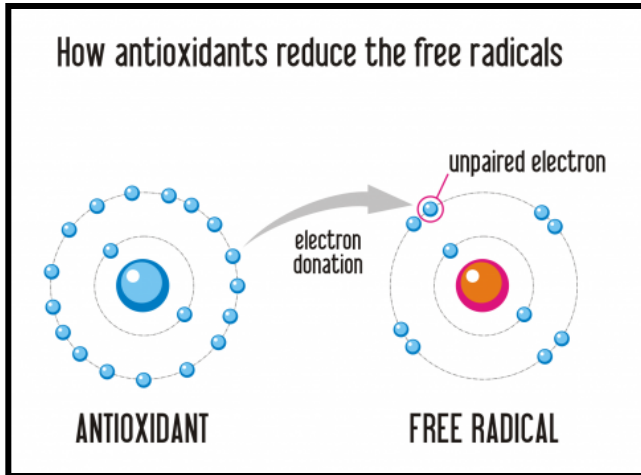


## Reactive Oxygen Species (ROS)



- Most free radicals are ROS formed as by-products of normal cell processes: use of oxygen (oxidation) for energy production and food metabolism; pathogen killing by phagocytes.
- Also formed by exposure to various environmental and life-style factors: radiation, solar UV rays, tobacco smoke, air pollution, poor diet, emotional stress
- **And most recently, exponential proliferation of wireless devices and systems!**

# Antioxidants: Free Radical Scavengers



## ❖ Intracellular enzymes

- Glutathione peroxidase
- Catalase
- Superoxide dismutase

## ❖ Exogenous and endogenous antioxidants

- Vitamin A
- Vitamin C
- Vitamin E
- Cysteine
- Glutathione
- Selenium

-melatonin

- Antioxidants detoxify free radicals by donating an electron, thus creating stable molecules in which every atom is ringed by pairs of electron.
- Critical to cell health: maintain proper balance between ROS production and consumption, thereby preventing unrestrained ROS activity ('oxidative stress').
- Our body requires ~ 60 antioxidants, consisting of intracellular enzymes and numerous dietary constituents abundant in fruits, vegetables, grains, meats, poultry and fish.
- Natural sleep-inducing hormone, melatonin, is a powerful antioxidant, effective in both aqueous & lipid phases; crosses the blood-brain barrier; high levels in mitochondria.



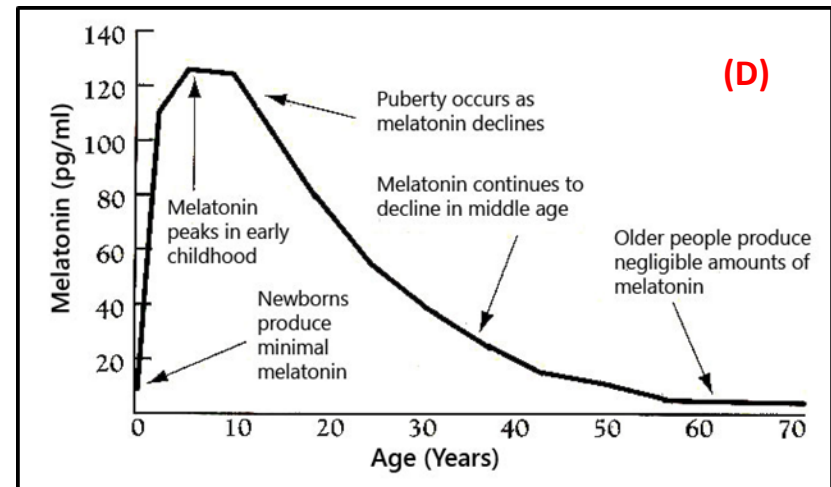
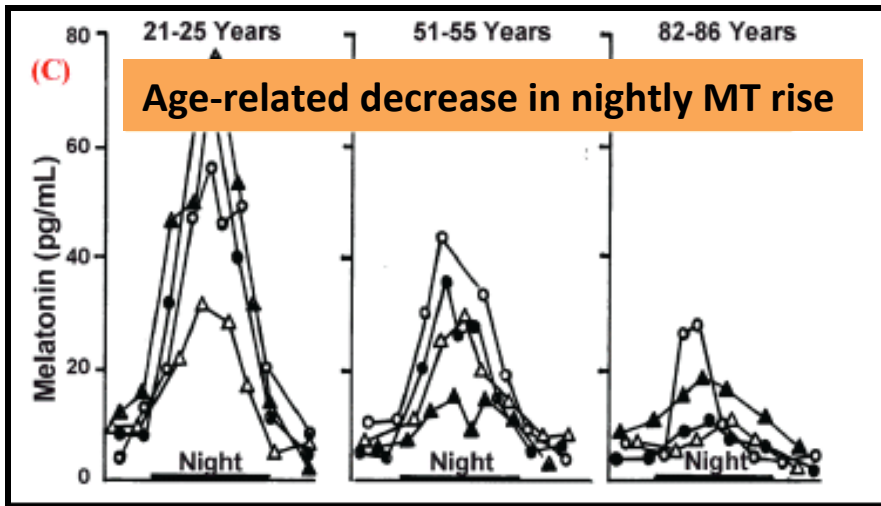
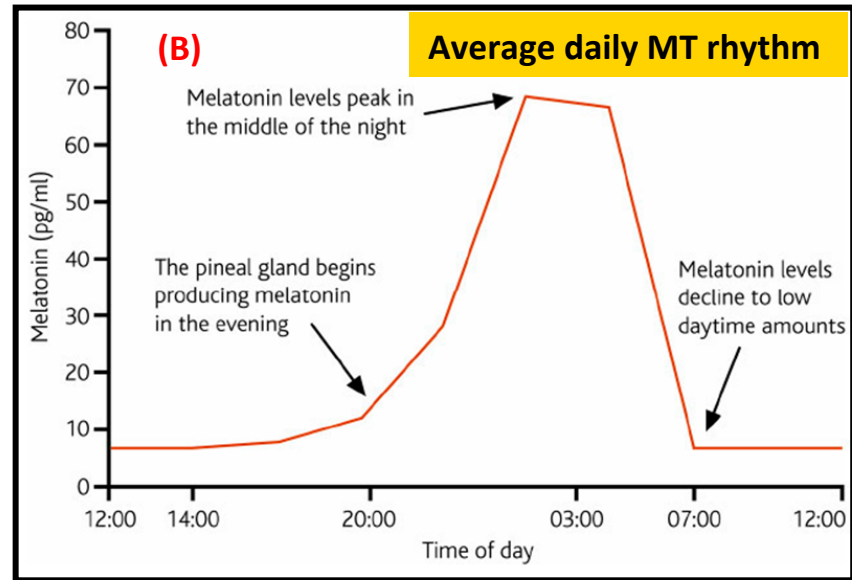
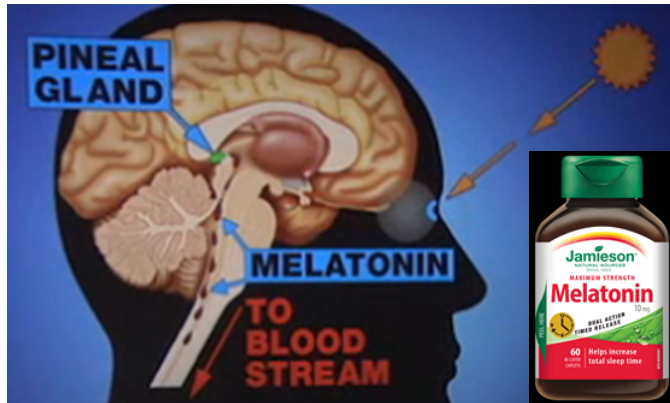
# Melatonin (MT) Disruption Hypothesis



- Power-line magnetic fields (MFs) increase risk of cancer & other illnesses by disrupting nocturnal MT synthesis
- MT: powerful antioxidant, more effective than vitamin C or E; crosses blood-brain barrier; high levels in mitochondria
- MFs suppress blood plasma and pineal MT levels in rats, hamsters and baboons
- MFs suppress MT production in humans; seen in 11 studies, both laboratory controlled & observational (population)
- MT protects against radiation-induced oxidative damage to human lymphocytes
- MT protects against oxidative damage to fetus in animals; significant as initiating event in childhood cancer appears to occur in utero
- Plausible mechanisms underlying MT disruption:
  - (i) reduced activity of rate-limiting enzyme for MT synthesis;
  - (ii) generation of free radicals by MFs, increasing demand on MT for free radical scavenging.

# Melatonin (MT) Production in Humans

(A)



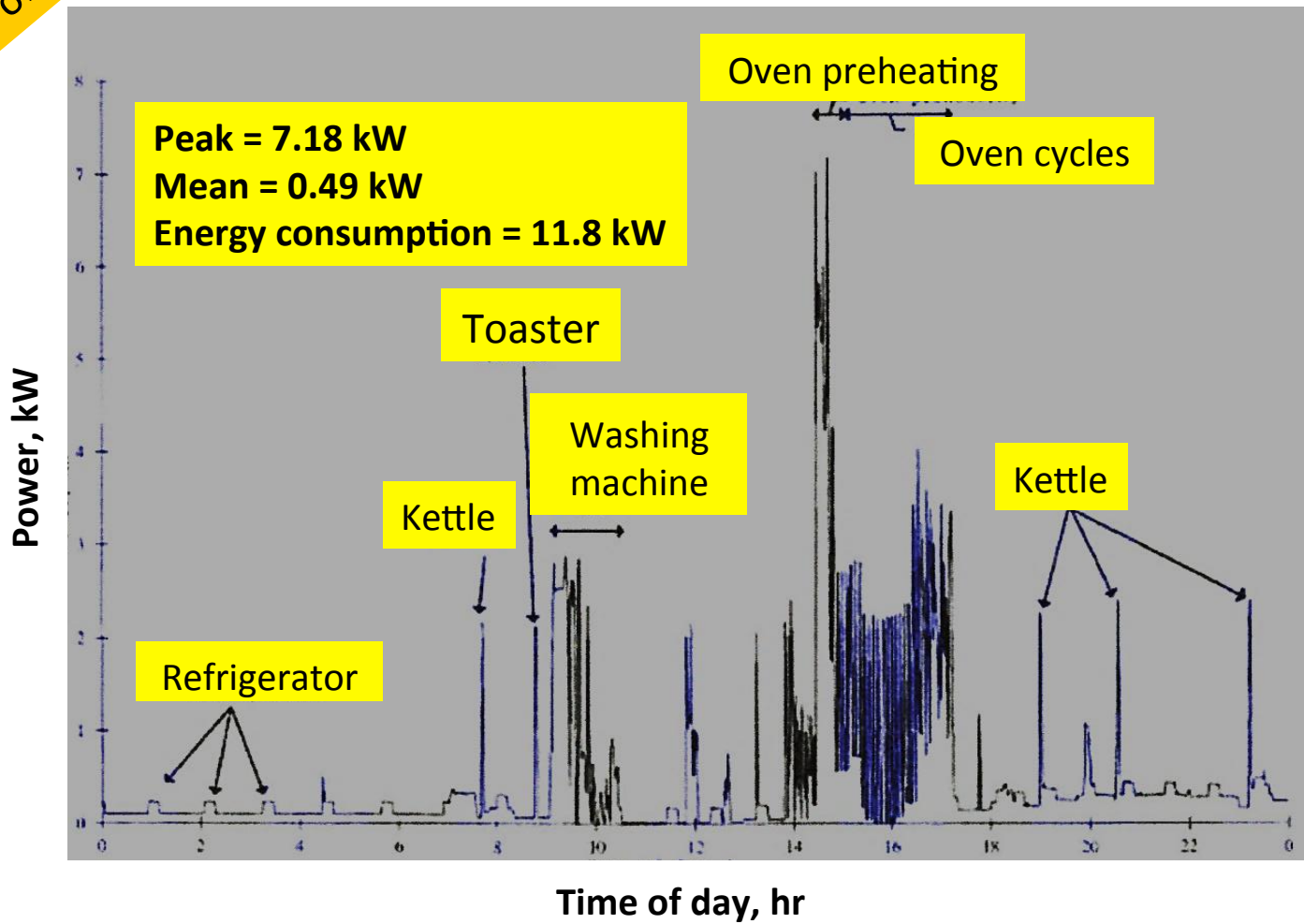
MT production: (A) release from pineal gland during night time; (B) nightly rise in plasma MT; (C) decline in nightly plasma rise with increasing age; and (D) plasma levels as function of age.

# Who Wants Smart Meter Data?

Who wants smart meter data?	How could the data be used?
Utilities	To monitor electricity usage & load; to determine bills
Electricity usage advisory firms	To promote energy conservation & awareness
Insurance companies	To determine health care premiums based on unusual behaviours that might indicate illness
Marketers	To profile customers for targeted advertisements
Law enforcers	To identify suspicious or illegal activity
Civil litigators	To identify property boundaries, activities on premises
Landlords	To verify lease compliance
Private investigators	To monitor specific events
The press	To obtain information about famous people
Creditors	To determine behaviour reflecting creditworthiness
Criminals	To identify pricey appliances to steal, burglary timing

Invasion of Privacy

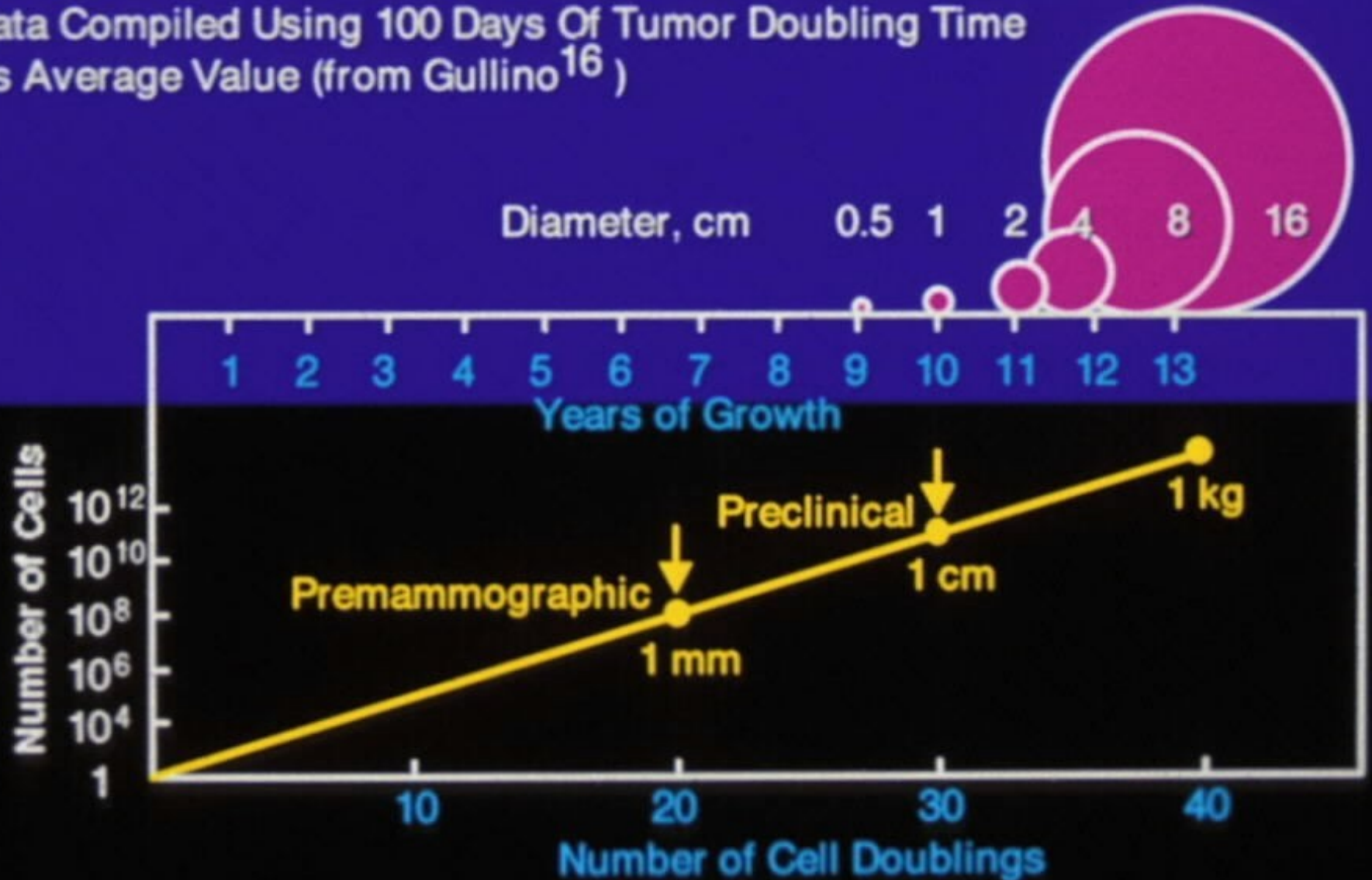
# Man, you drink a lot of tea!



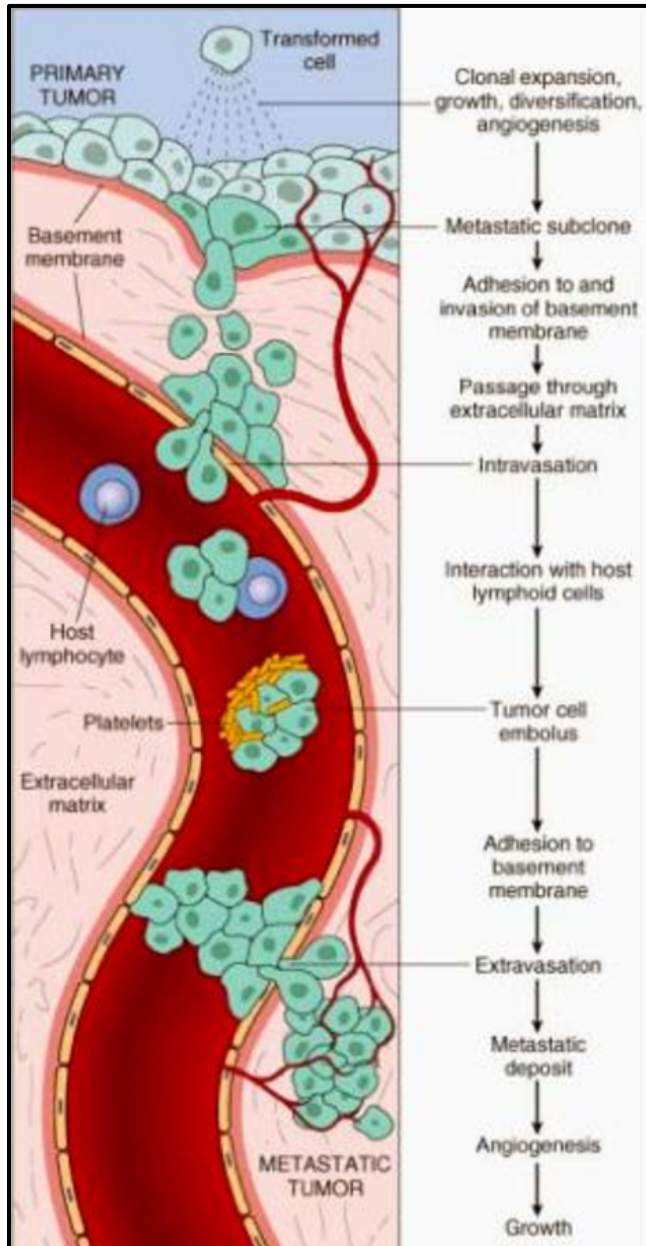
- Smart meters can collect detailed individual household's electricity demands
- Each appliance has its own energy fingerprint ('appliance load signature')
- Reveal types of appliances & how often used; when you get up, go to sleep & when out
- Technology that can 'pierce the blinds'.

# Long Preclinical Existence of Breast Cancer

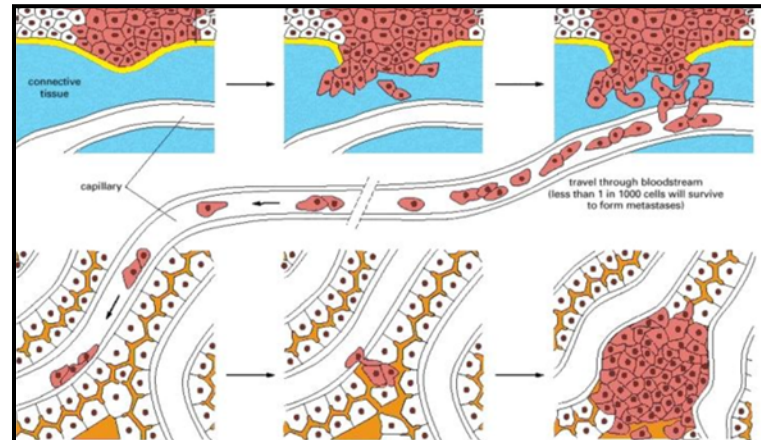
Data Compiled Using 100 Days Of Tumor Doubling Time  
As Average Value (from Gullino<sup>16</sup>)



# Notes on Metastasis



- Tumors become **life-threatening** when they **evade & subvert** defense systems **confining** them to **origin**.
- **Spawn pioneer cells** that **colonize** sites where **space & nutrients** not limiting; **interfere** with **vital systems**.
- **Tumor cells** are **shed** from **primary tumor mass** at **earliest stages** of **malignant progression**.
- **Circulating tumor cells (CTCs)** must **evade immune cells** in lymphatics/blood stream & **adhere** to vessel **wall**.
- Less than **1 in 10,000** will **survive** to form **metastases**.
- Hidden **CTCs** are **source** of eventual **lethal metastases**, **major cause** of **treatment failure**.
- **Detection & characterization** of **CTCs** is promising for both **diagnosis** and **treatment monitoring**.
- **Novel microenvironment** must be **established** at **distant site** for tumor cells to **proliferate**.



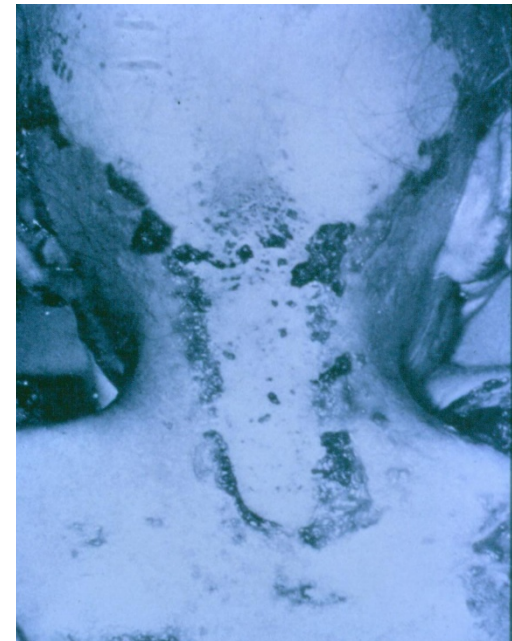
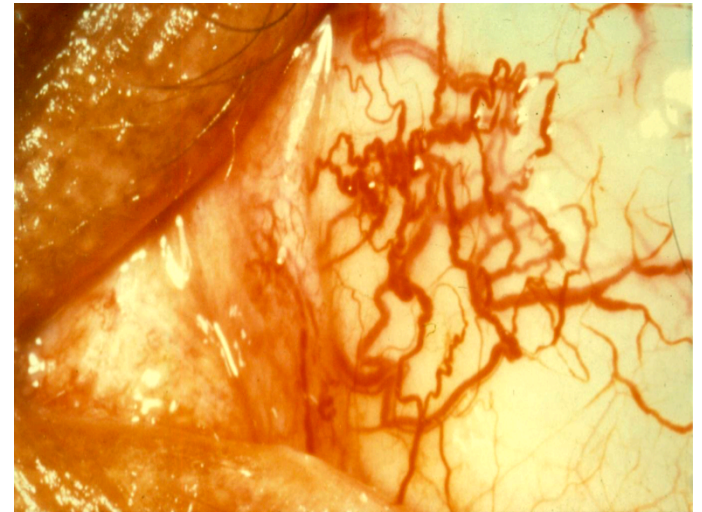
# Ataxia - Telangiectasia

(complex, single gene trait; 1 per 40,000)

## Clinical Features:

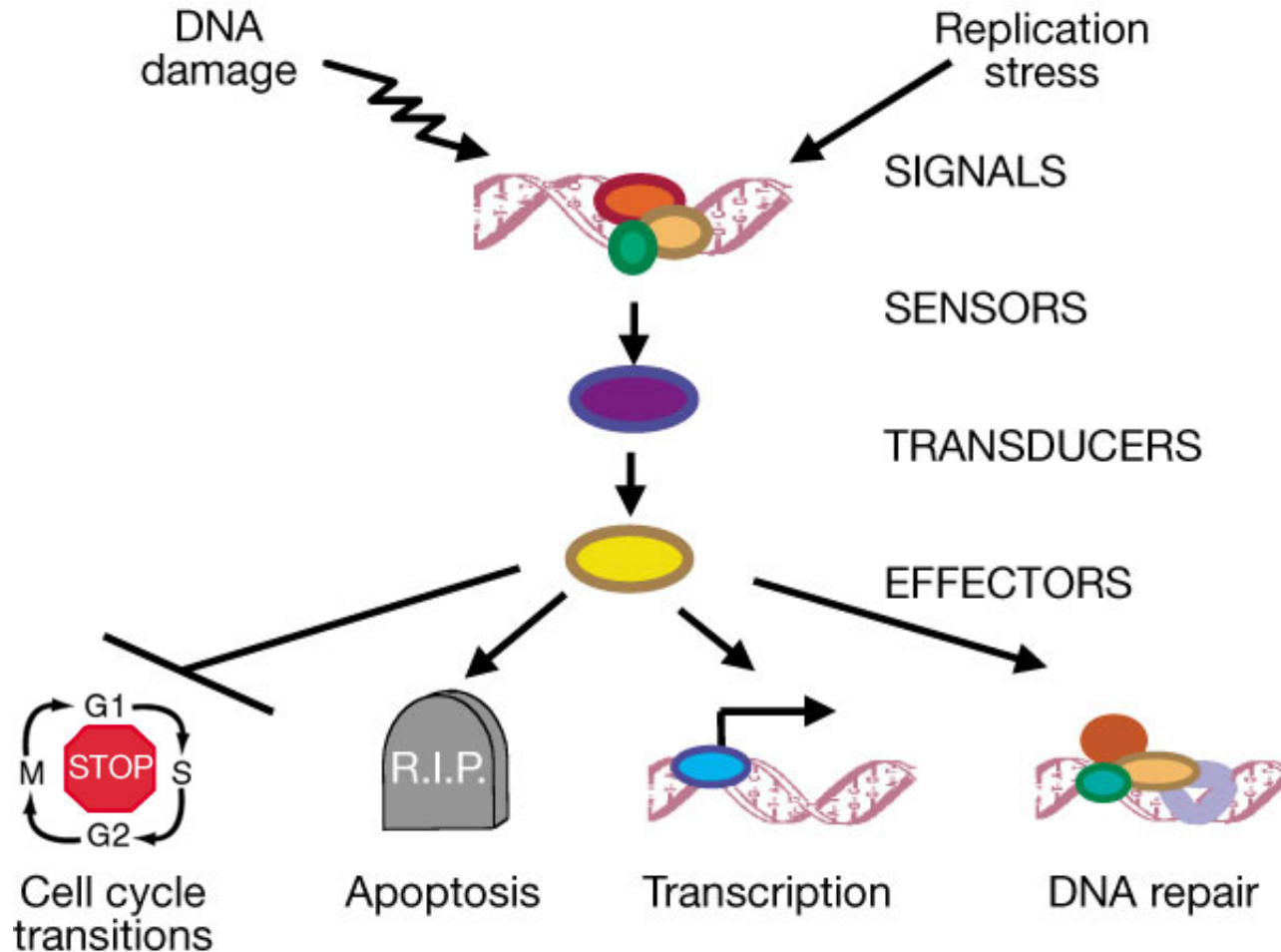
- **Muscular incoordination**
- **Blood vessel dilation (eyes & skin)**
- **Defective immunity (respiratory infection)**
- **Cancer - prone (lymphomas & leukemias)**
- **Hypersensitivity to radiotherapy**

# Clinical Hallmarks of Ataxia-telangiectasia





# General outline of DNA-damage response signaling pathway

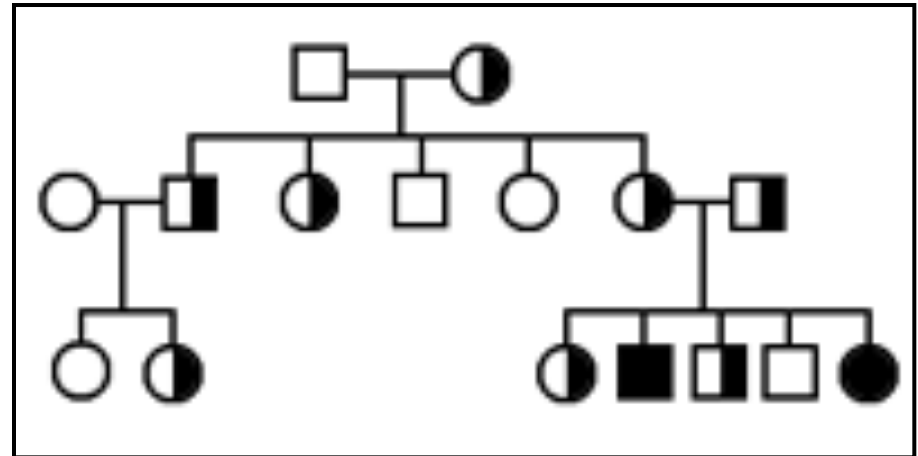


Modified from: B S Zhou and S J Elledge. *Nature* 408: 433 (2000)

# AT heterozygotes: a cancer-prone population

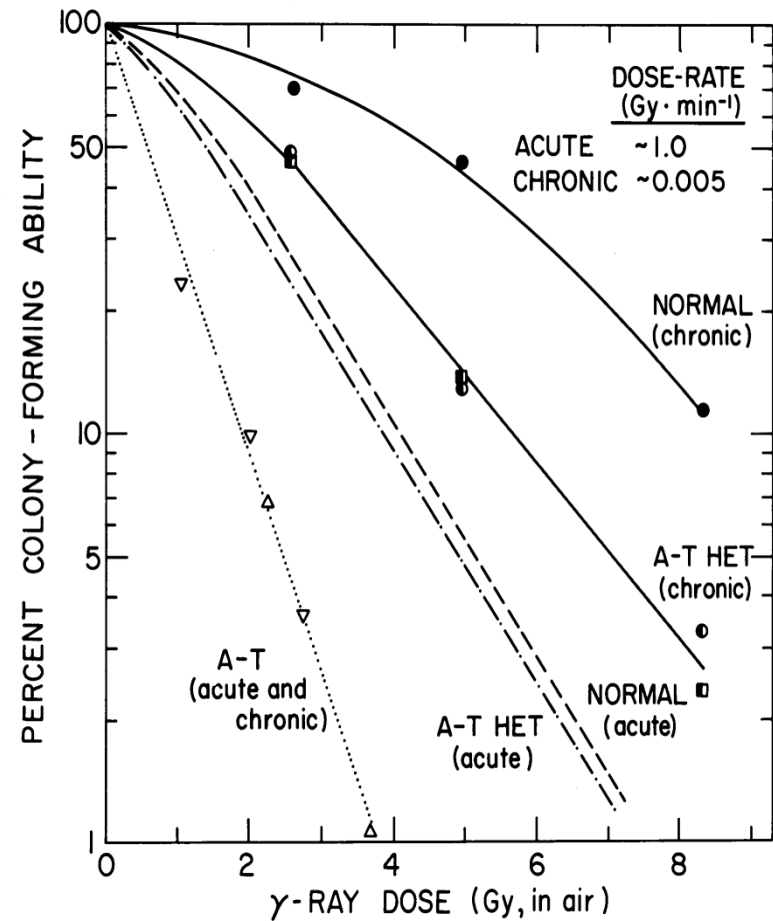
- **Swift studied incidence of cancer in families of AT patients**
- **Striking cancer excess in AT families, leading to prediction that ~ 5%\* of all cancer deaths below age 45 arise in heterozygous carriers**

**\* estimated heterozygote frequency (1% of general population) X relative mortality risk (five times normal)**



# A-T heterozygotes also display enhanced radiosensitivity *in vitro*

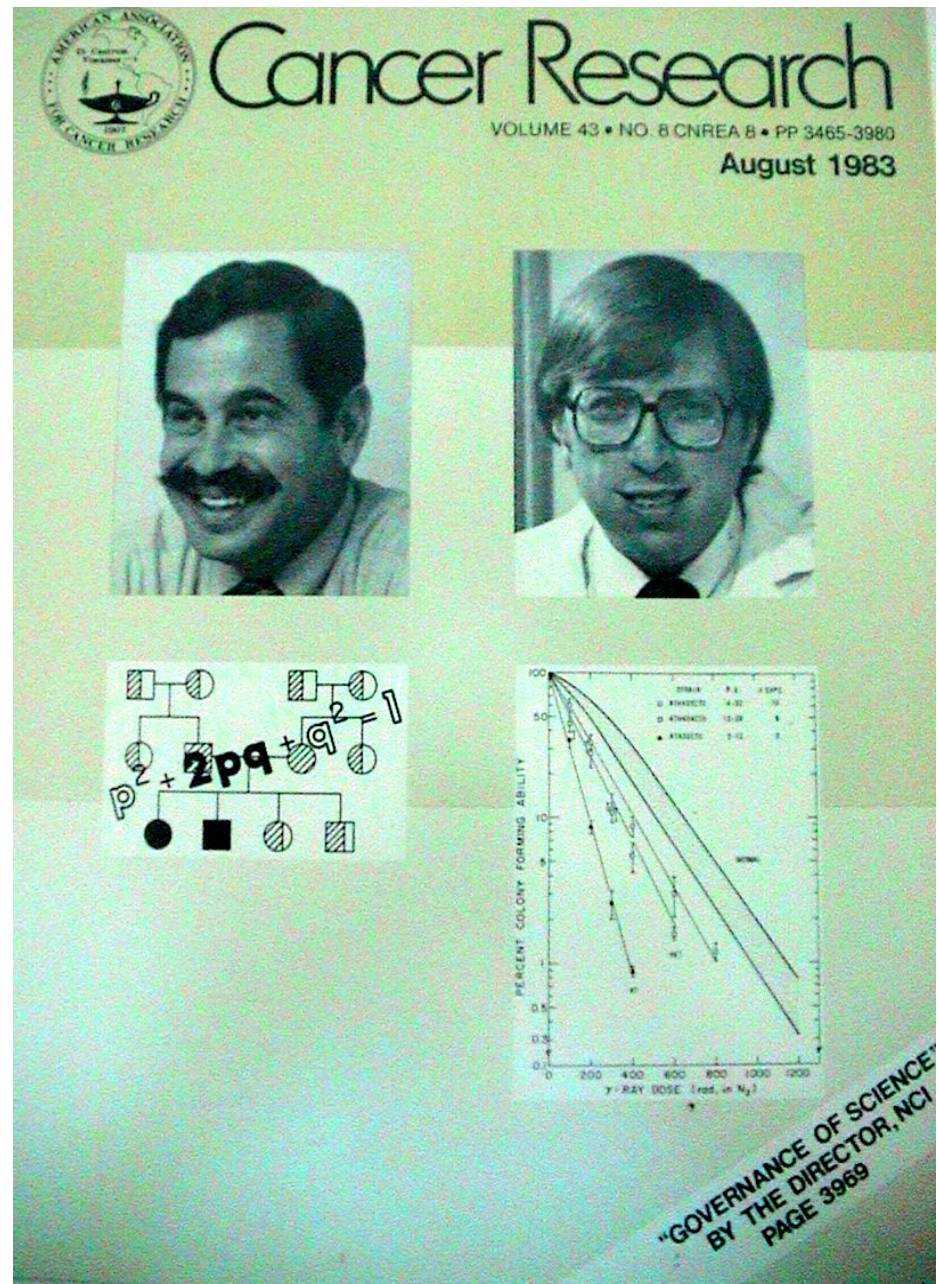
- In 1976, we showed that some, but not all, obligatory A-T heterozygotes displayed impaired colony-forming ability in response to radiation delivered under hypoxia
- These epidemiologic and lab findings demonstrated how genetic and environmental factors may interact in cancer pathogenesis

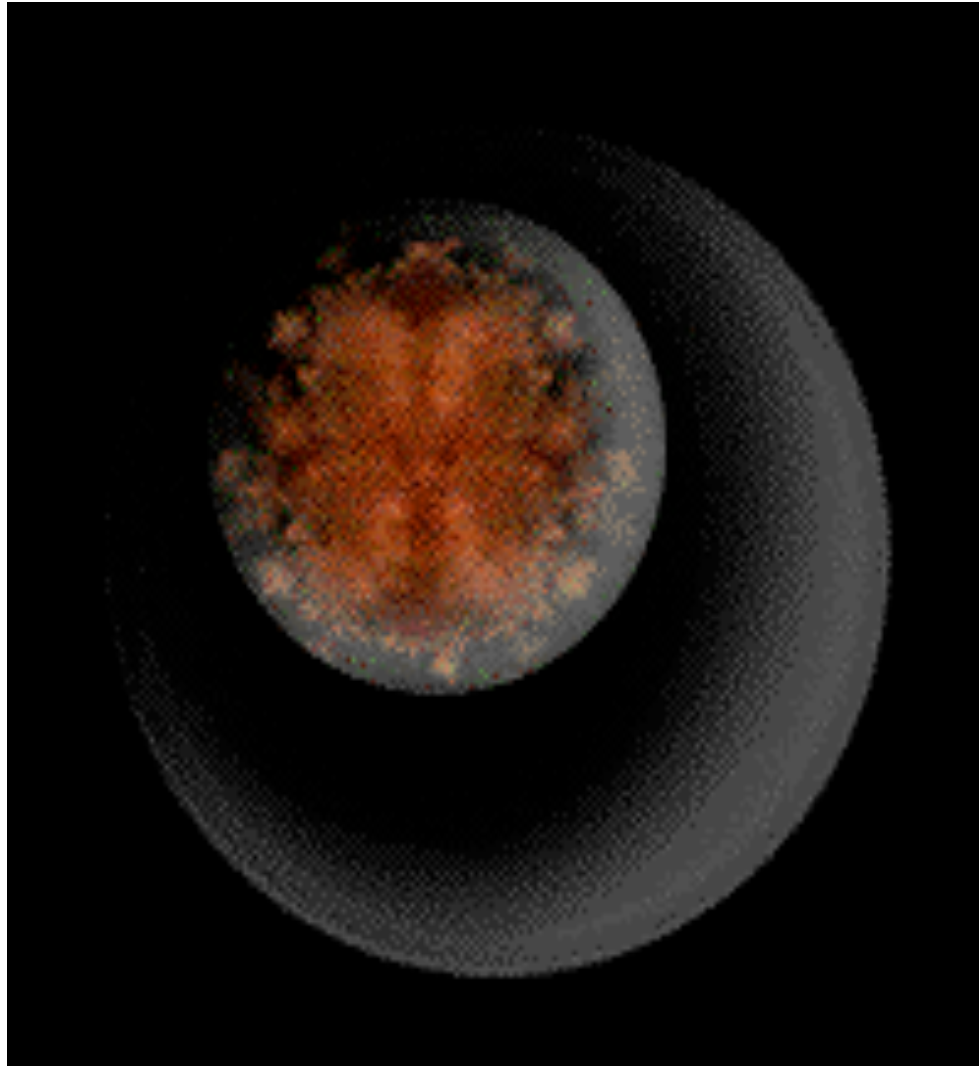


**A-T heterozygotes: a cancer-prone population displaying enhanced radiosensitivity *in vitro***

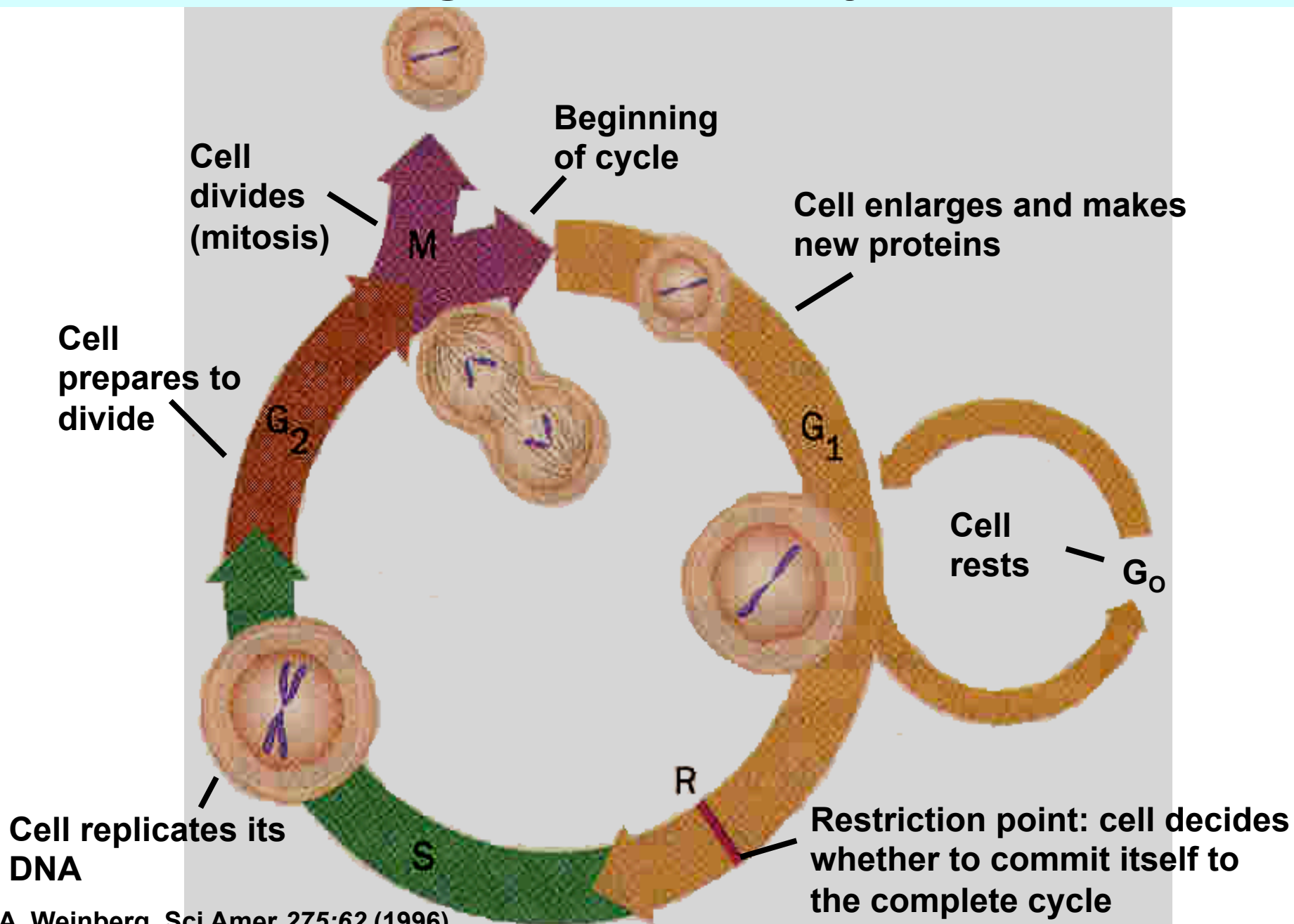
**Cited as *exemplar* of genetic-environmental interactions in cancer development**

**Cancer Res  
43(8), Aug 1983**

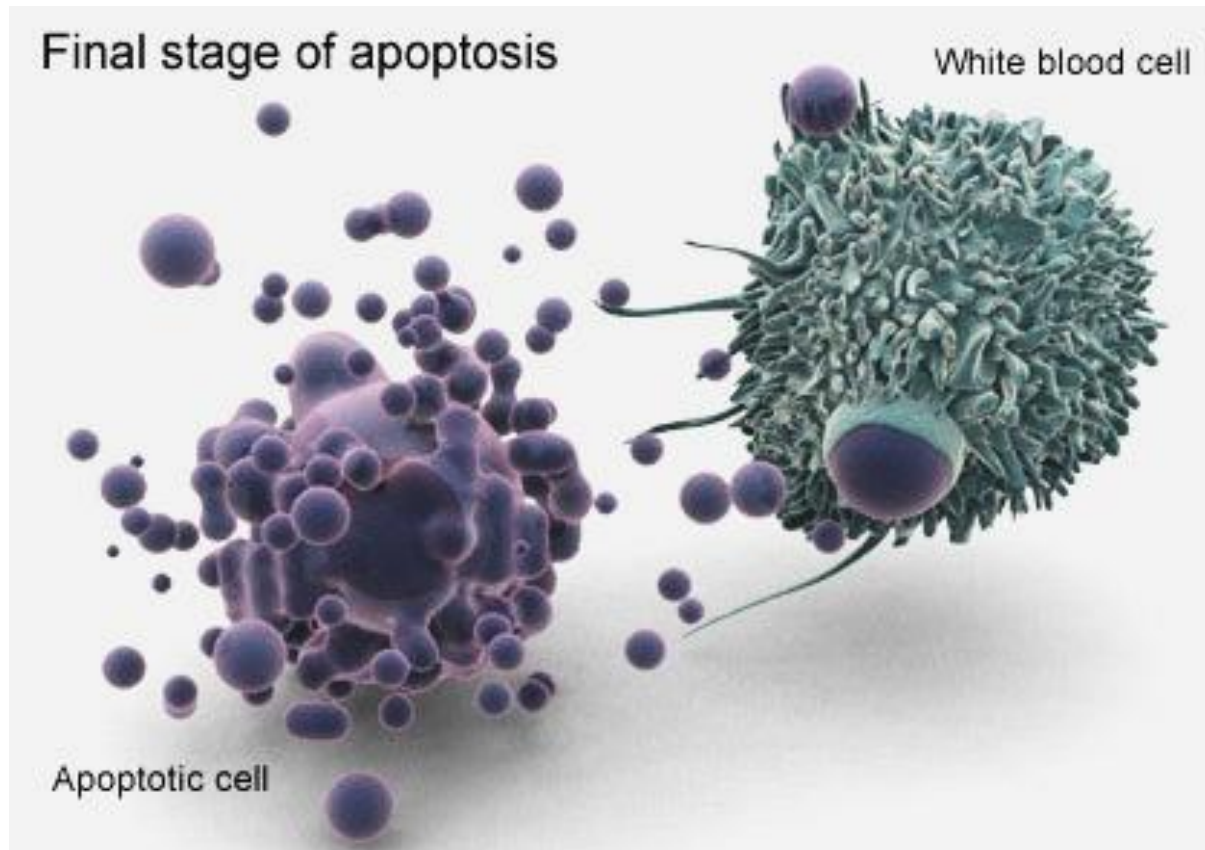




# Stages of the Cell Cycle



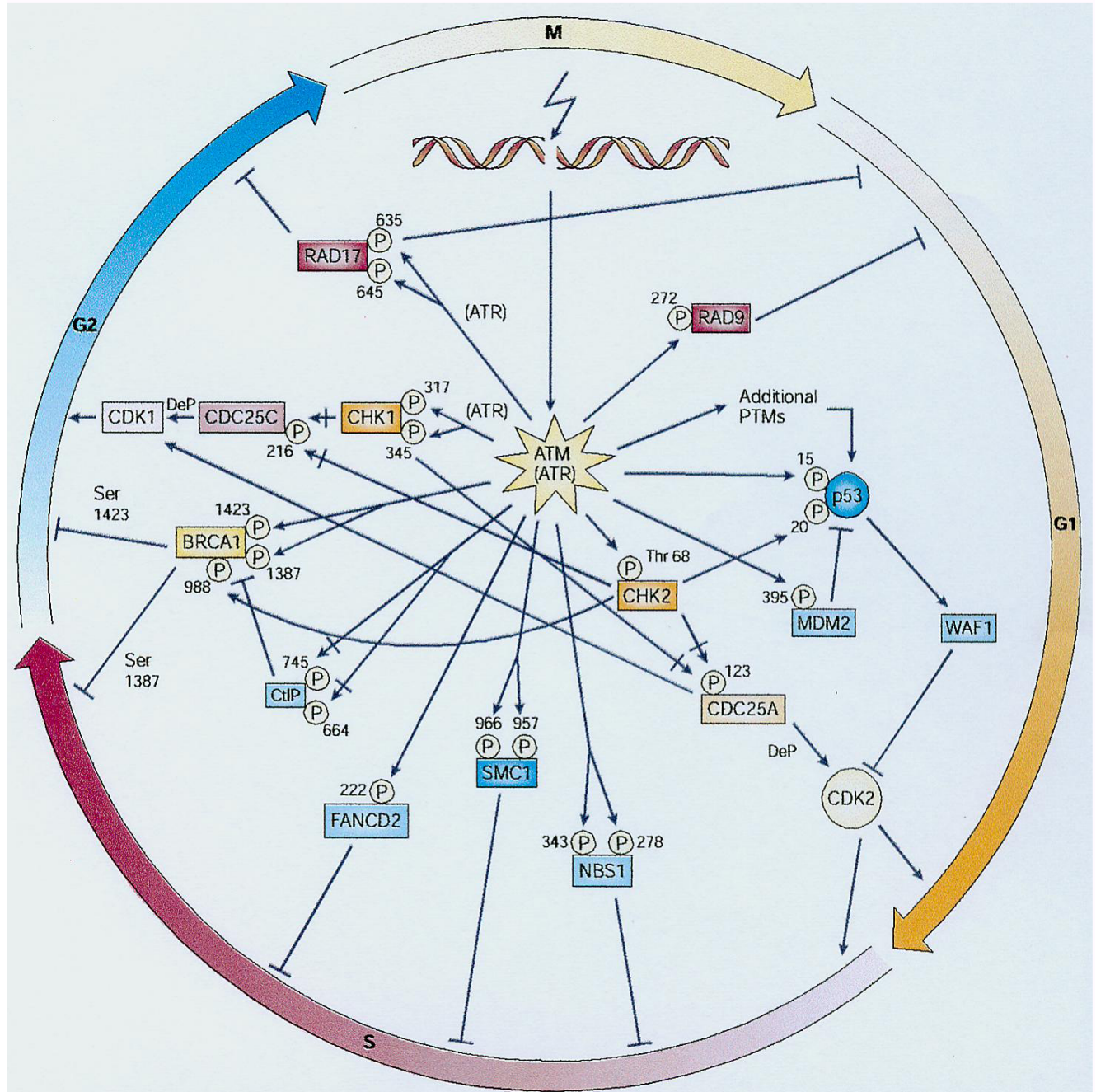
# Cell Membrane 'Blebbing' in Apoptosis



- **Apoptosis** (programmed cell death) used to **remove cells** that are either **badly damaged** or otherwise **no longer needed**
- In **adults, 50-70 billion cells** are **destroyed** each **day** by apoptosis.

# ATM-mediated activation of cell-cycle checkpoints in response to double-strand breaks

- arrows indicate stimulation
- T-shaped lines: inhibition
- inhibitory phosphorylation: line through arrow
- dephosphorylation 'DeP'





## BIAS IN CASE CONTROL STUDIES

- **SELECTION BIAS:** systematic error due to differences in characteristics between those selected for a study and those not selected

**EXAMPLE in CC Studies:** When cases are selected from a hospitalized population with unique exposures, controls often are not representative of the population that gave rise to cases

## Case-Control Checklist

### Key Components

- **Study base** - all people who would be in the study if they developed the disease
- **Disease (case definition)** - clear definition, newly diagnosed
- **Controls** - random sample of those without disease in study base
- **Exposure** - interview cases and controls
- **Confounders** - what could confuse the results?
- **Analysis** - how was the information handled?
- **Selection Bias** - were the populations similar? Were they "normal?"

## Summary – Case Control Studies

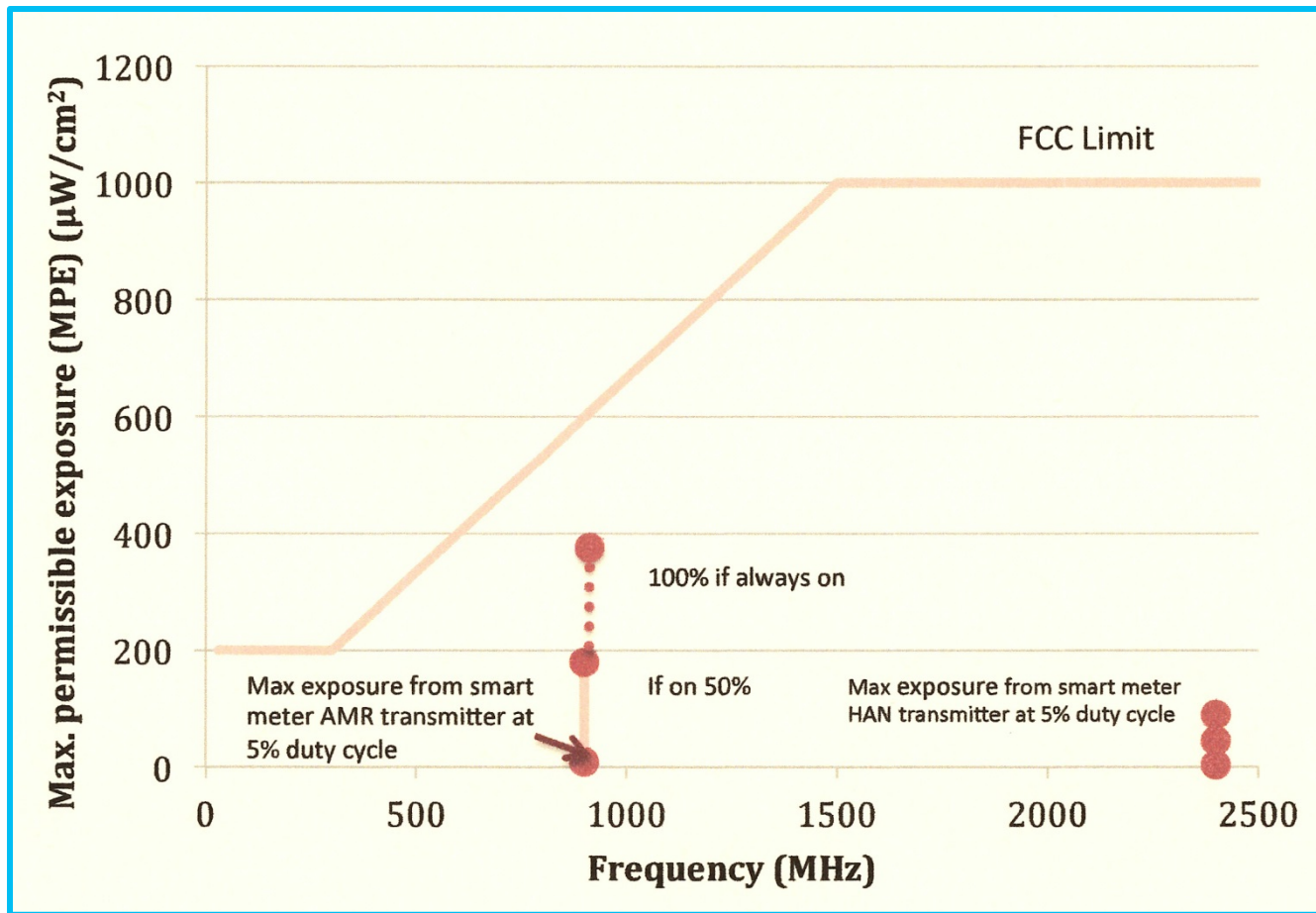
- Selection of an **appropriate comparison group** is the most challenging and important aspect of the study design.
- In population-based studies, incidence can be calculated when entire population is sampled.
- Hospital-based studies are often easiest and cheapest to conduct, but may be prone to biased exposure ascertainment.

# **Case-Control Checklist**

## **Key Components**

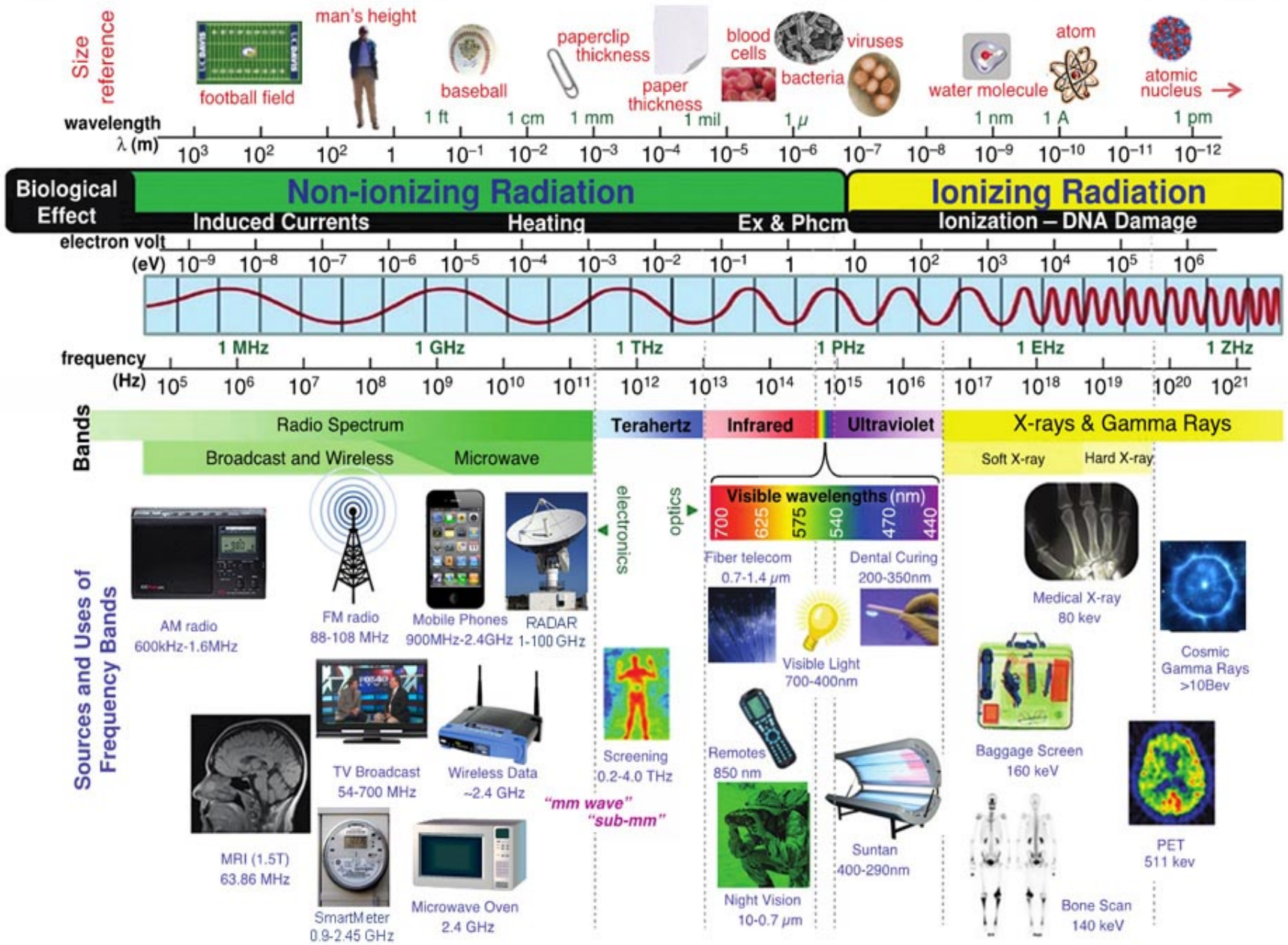
- **Study base – all people who would be in the study if they developed the disease**
- **Disease (case definition) – clear definition, newly diagnosed**
- **Controls – random samples of those without disease in study base**
- **Exposure – interview cases and controls**
- **Confounders – what could confuse the results?**
- **Analysis – how was the information handled?**
- **Selection bias - were the populations similar? Were they ‘normal?’**

# FCC Maximum Permissible Exposure Limits

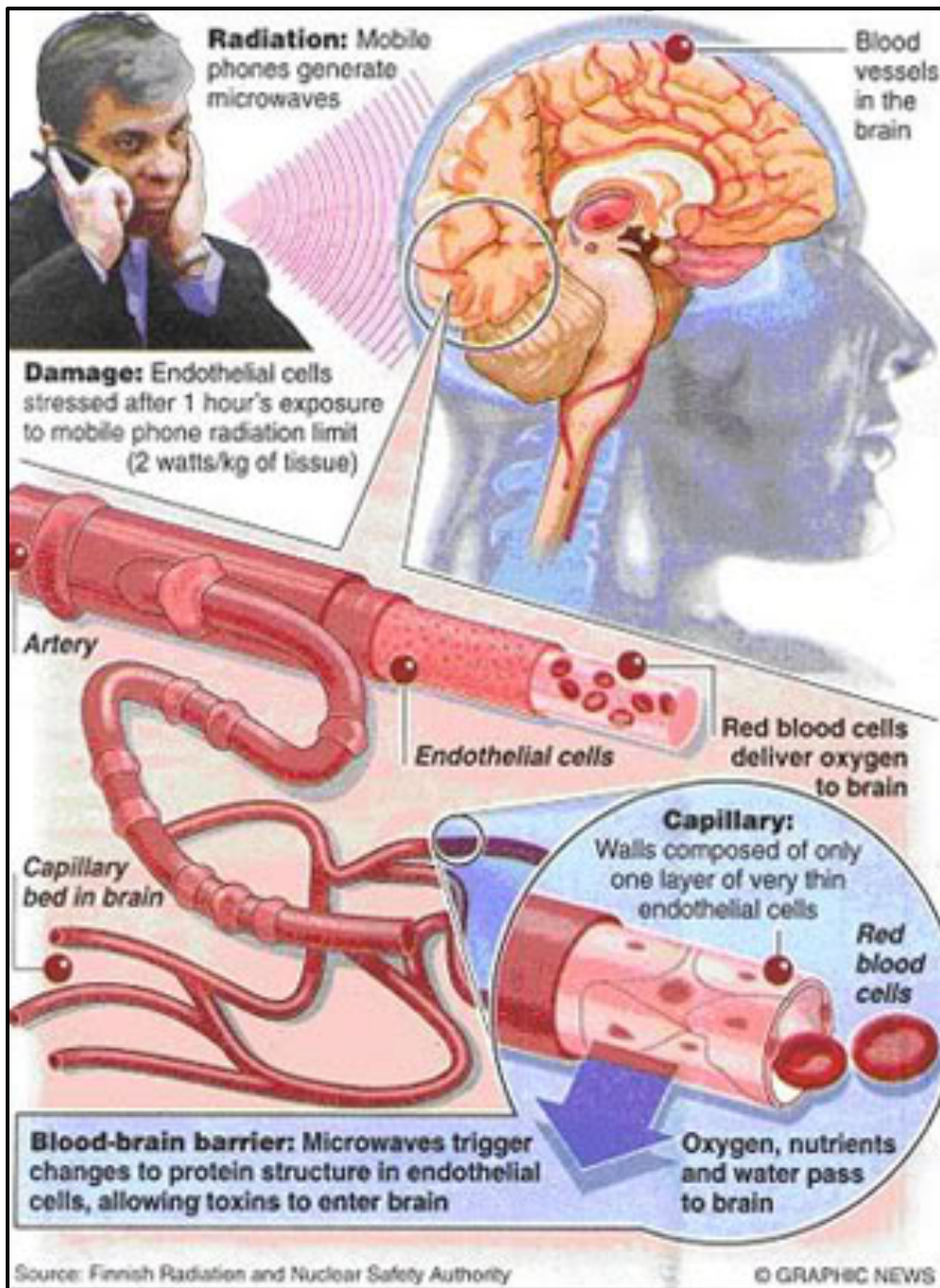


- Power density limits rise with freq.; our body can safely absorb more energy at higher freq.
- Max. exposure from 1-W AMR transmitter at 5% duty cycle (72 min/day), 1-ft away is 18  $\mu\text{W}/\text{cm}^2$  or 3% FCC limit ; if faulty & always on (100% duty cycle) , level would be 60% limit
- For 250 mW HAN transmitter: 5% duty cycle, 3% of FCC limit; 100% duty cycle, 9% of limit.

# ELECTROMAGNETIC RADIATION SPECTRUM



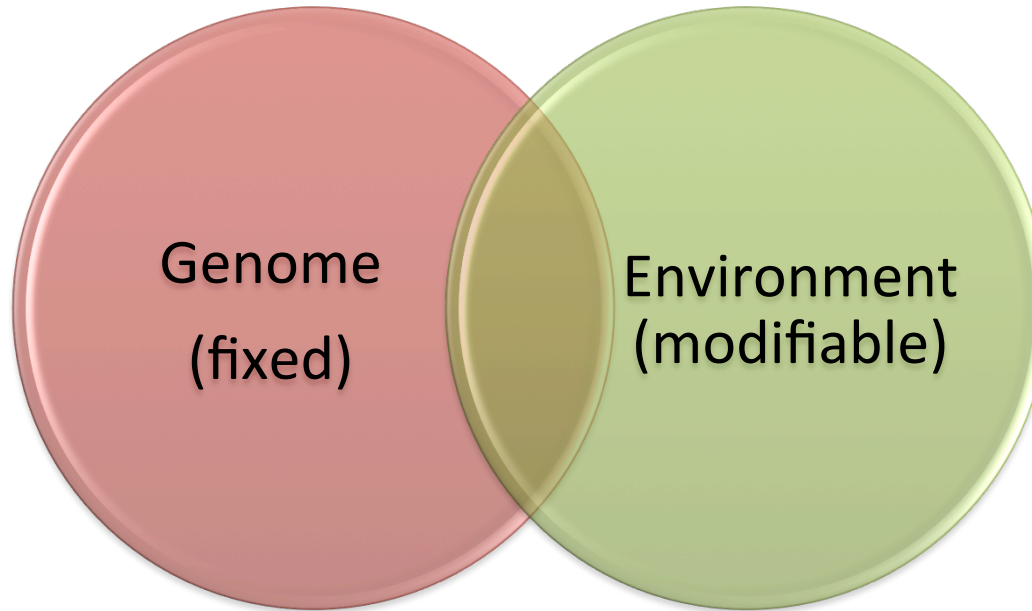
# Leakage of Blood-Brain Barrier



# Features of EHS Syndrome

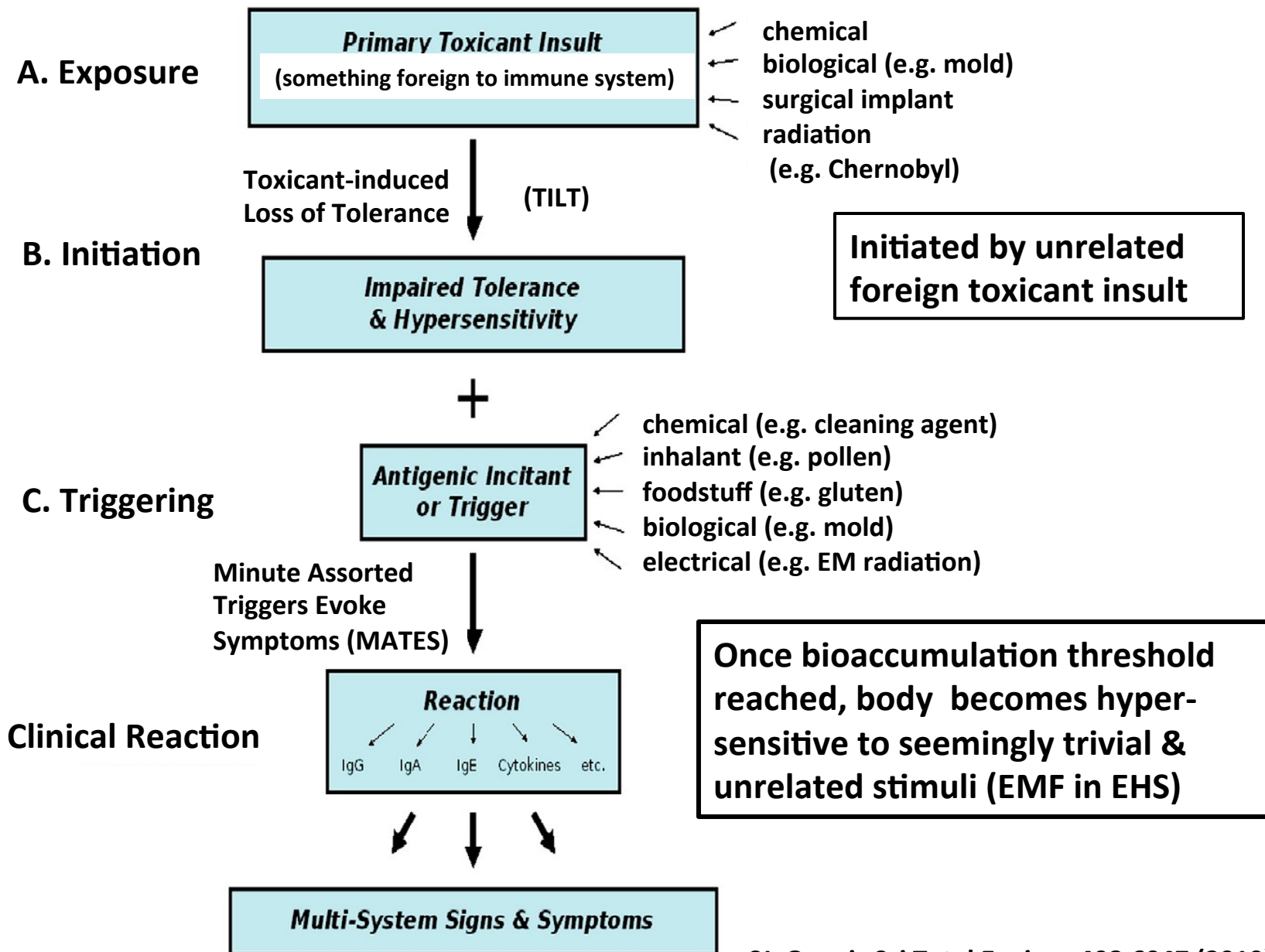
- **One aspect of Idiopathic Environmental Intolerance (IEI) ascribed to radiation from everyday RF-emitting devices**
- **Reflects person's total environmental burden, overall health & how their unique bioelectric cellular chemistry responds to external EMR.**
- **Afflicted persons may have associated biochemical deficiencies, toxicant bioaccumulation and genetic polymorphisms that affect cellular detoxification processes, neurocognitive biology and other determinants of health and illness.**

# Cause of Chronic Illness



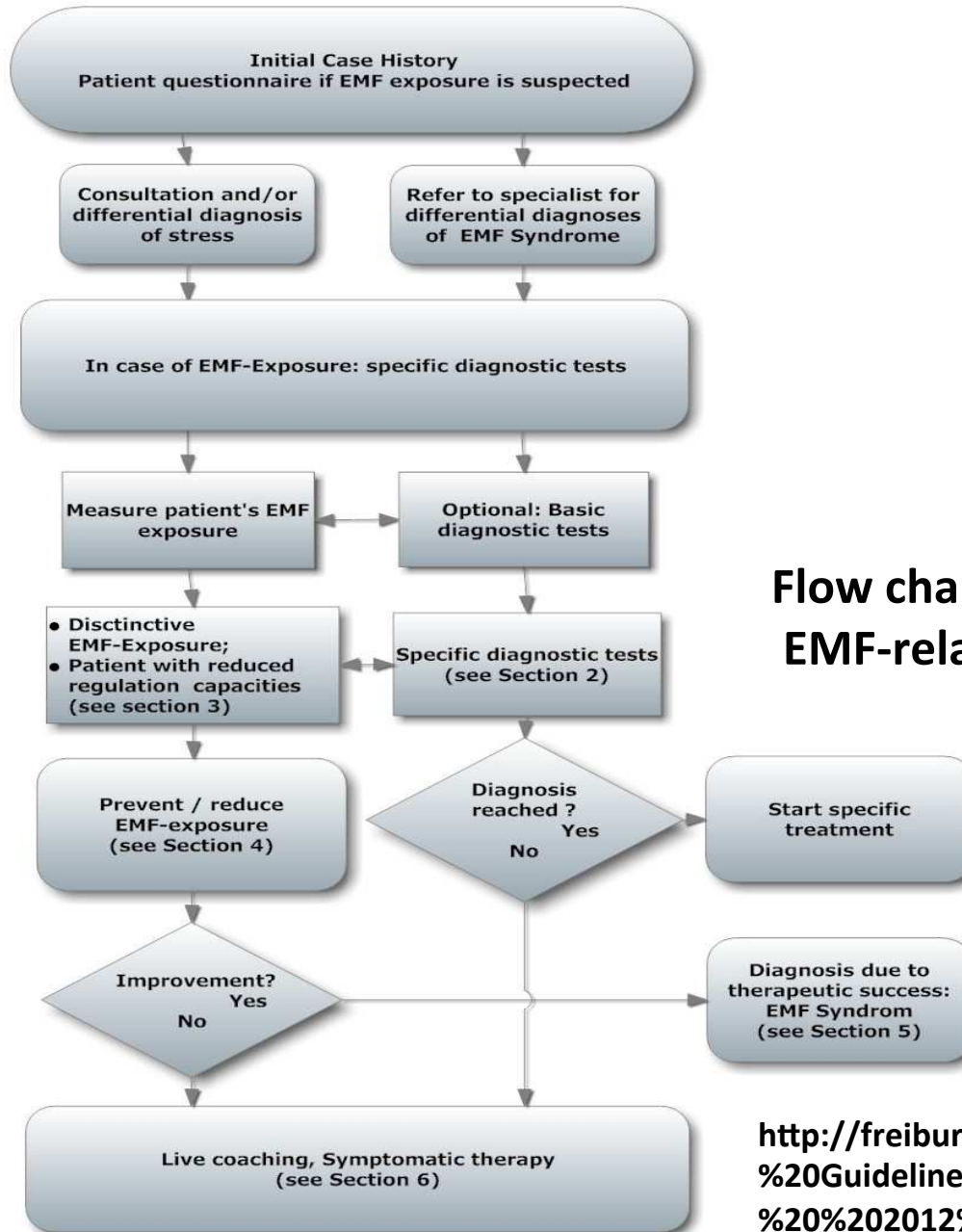
- **Interaction of genetic susceptibility factors and modifiable environmental factors (e.g. infectious, chemical, physical, nutritional and behavioral factors)**
- **Variations in genetic makeup associated with almost all disease**
- **Mediated by epigenetic mechanisms which regulate or modify gene expression**

# Pathway to Sensitivity-related Illness



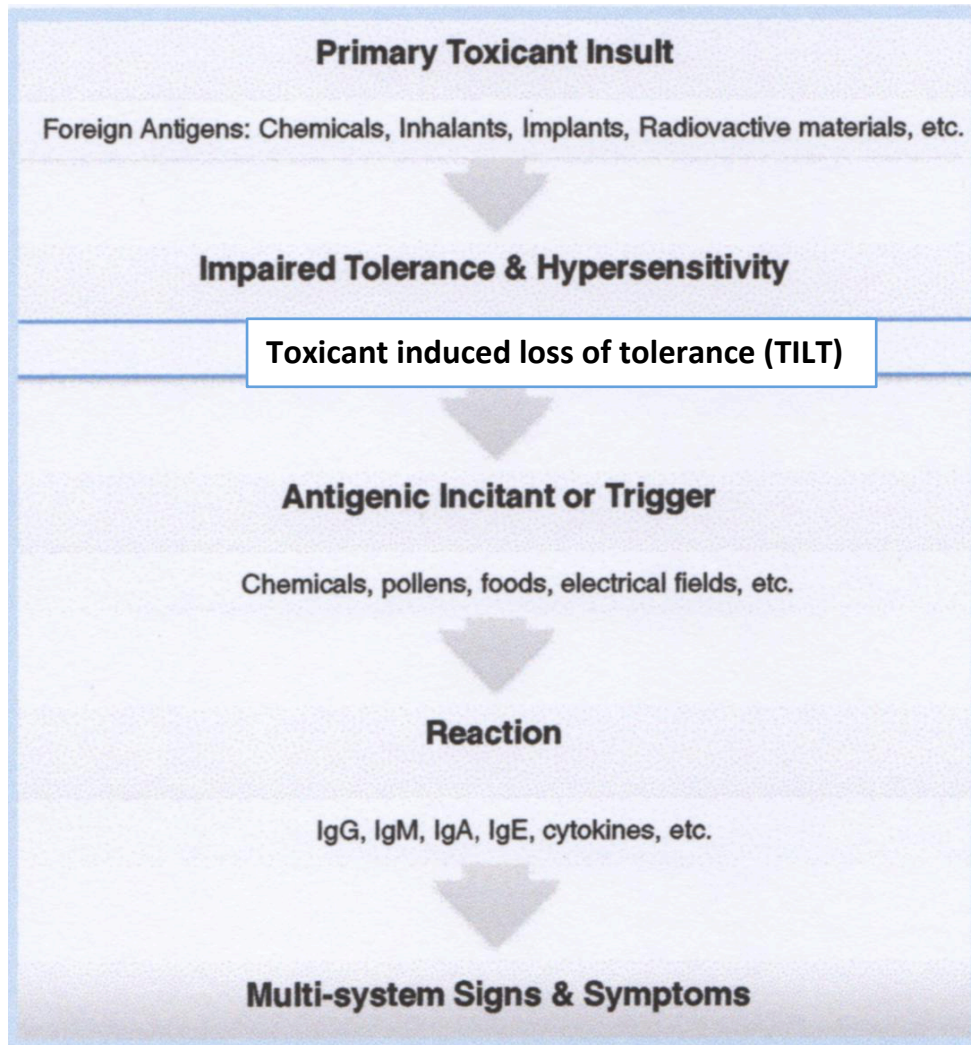


# Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF-related health problems and illnesses (EMF syndrome)



Flow chart for diagnosing EMF-related health problems

# Pathogenic Mechanism for Development of Sensitivity-related Illness



- Initiated by totally unrelated foreign toxicant insult
- Once bioaccumulation threshold reached, body becomes hypersensitive to seemingly trivial & unrelated stimuli (EMF in EHS)
- EHS: disruption of catecholamine production in response to EMR
- EHS based on person's total environmental burden, overall health & how their unique bioelectric cellular chemistry responds to external EMR.

# Statement from Dr. De Kun Li, MD, PhD, MPH Senior Research Scientist with Kaiser Permanente

Response to California Council on Science and Technology (CCST) (Posted 3/31/11)

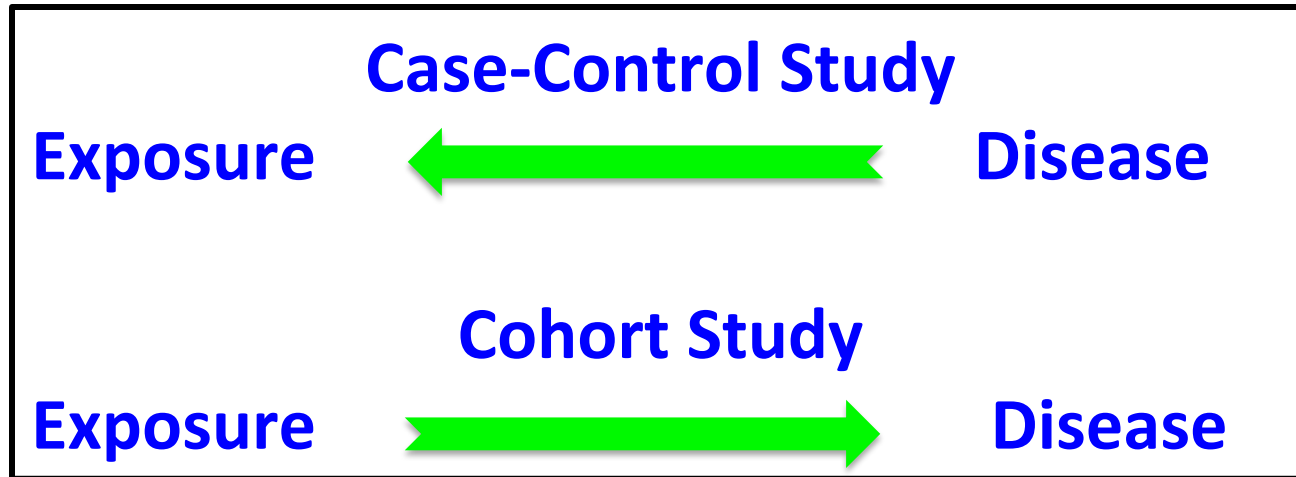
<http://www.ccst.us/publications/2011/2011smartresources.php>

“Currently there are no national or international “standards” for safety levels of radiofrequency devices. What the FCC is currently using are “guidelines” which have much lower certainty than a “standard”.

The bottom line is that the safety level for RF exposure related to non-thermal effects is unknown at present and whoever claims that their device is safe regarding non-thermal effects is either ignorant or misleading.”

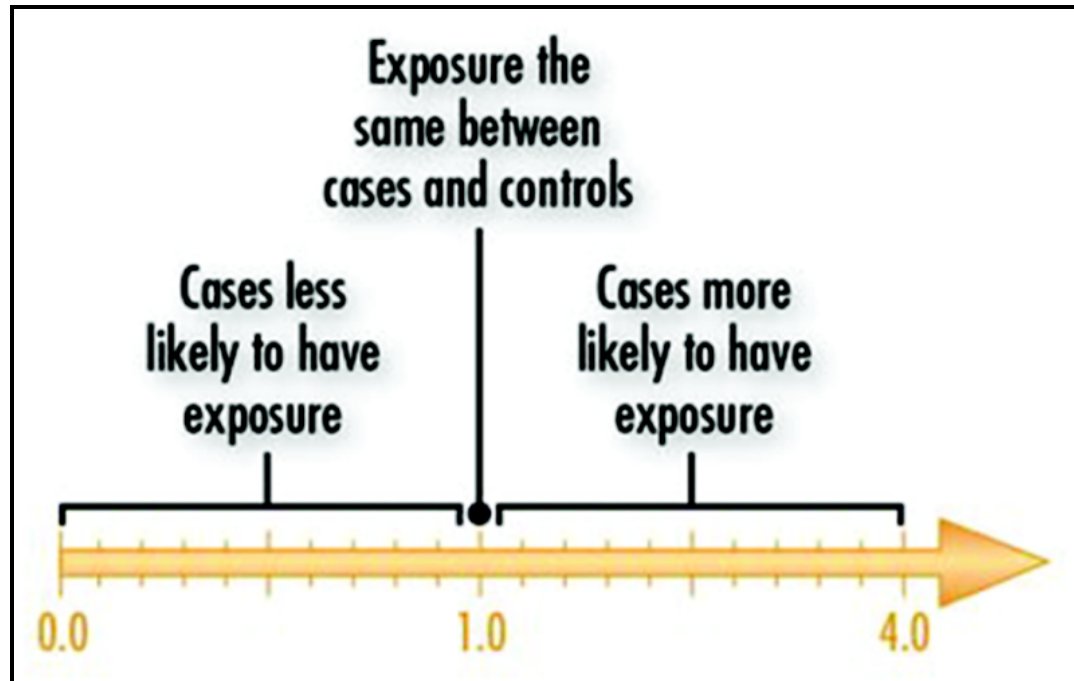
(Excerpted from full statement)

# Design of Case-Control & Cohort Studies



- **Case-control study:** traits of a group of persons with disease (cases) compared with those of a matched group without the disease (controls) (retrospective)
- **Cohort study:** population without disease is followed over time to see if persons with a certain exposure develop disease at a higher rate than unexposed persons (prospective)
- **Critically dependent on observational astuteness of the trained investigator.**

# Relative Risk & Confidence Interval

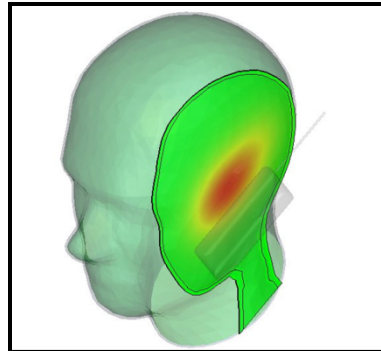


- RR reflects degree of correlation between suspected risk factor & disease
- RR = 1.0 infers no correlation between exposure & risk of disease
- RR = 2.0 infers risk twice as high in exposed compared to unexposed persons
- CI expresses the confidence that the result is not due to chance alone
- Even if RR is elevated, if CI overlaps the no-risk level of RR = 1.0, possible role of chance cannot be ruled out.

# SAM Phantom for SAR Evaluation: One Size Fits All

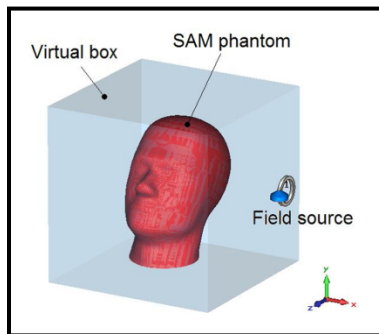


**SAM Phantom**

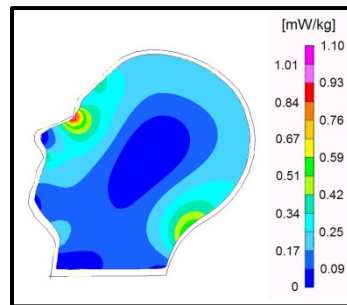


**Field contour**

- SAM (Specific Anthropomorphic Mannequin)
- Hollow plastic head containing 'tissue-equivalent liquid' simulating head (5kg) of a 6-ft adult male
- Fluid's average dielectric properties do not mimic precise chemical make-up of head
- Greatly underestimates absorbed radiation for most mobile phone users, especially kids.



**Phantom with  
RF field source**



**Map of induced SAR  
in vertical X-section**

# Percentages of Substances Classified in Each Category with Examples

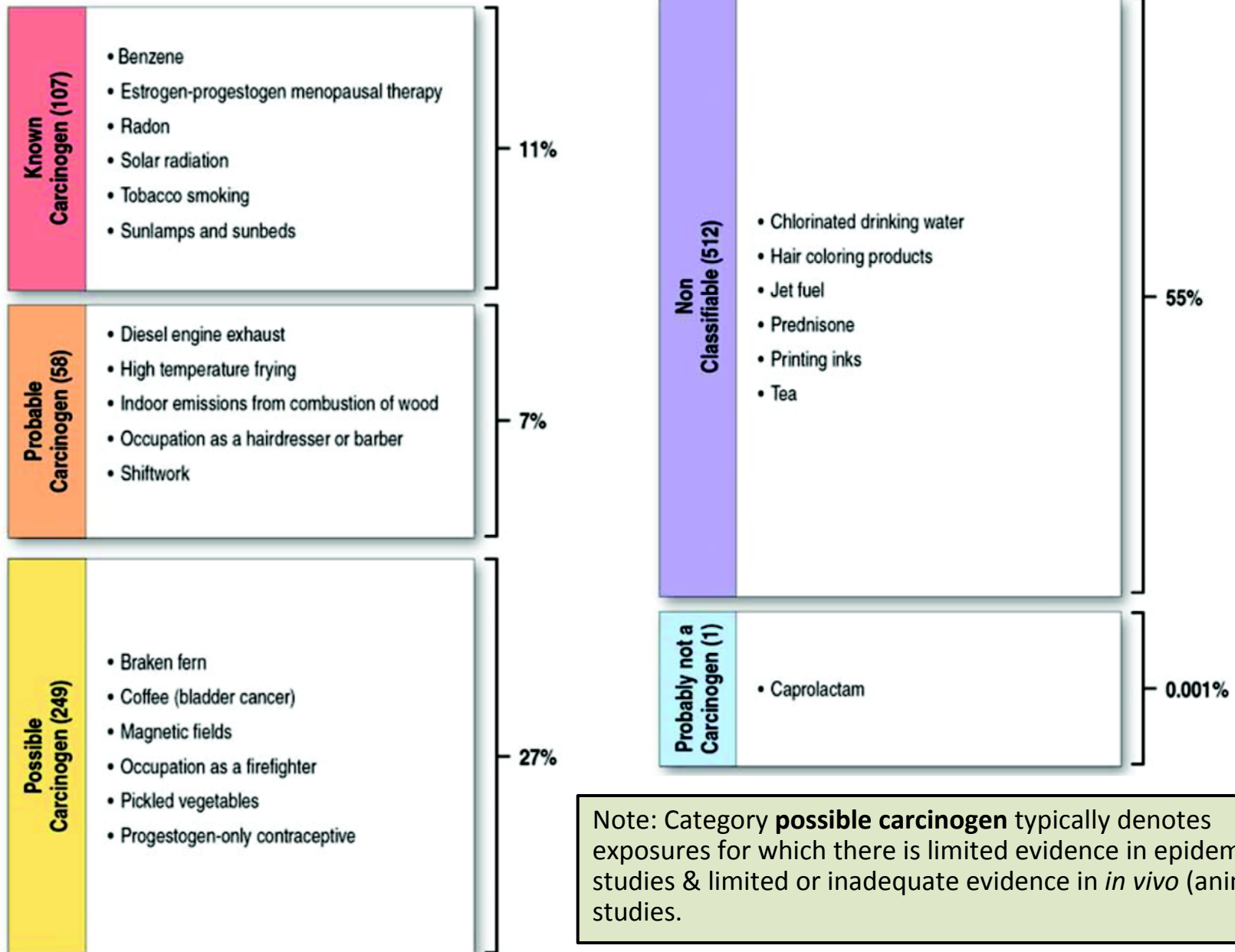




Figure 1. The smart home ecosystem



# Internet of Things

*A dynamic global network infrastructure*

*with self configuring capabilities*

*based on standard and interoperable communication protocols*

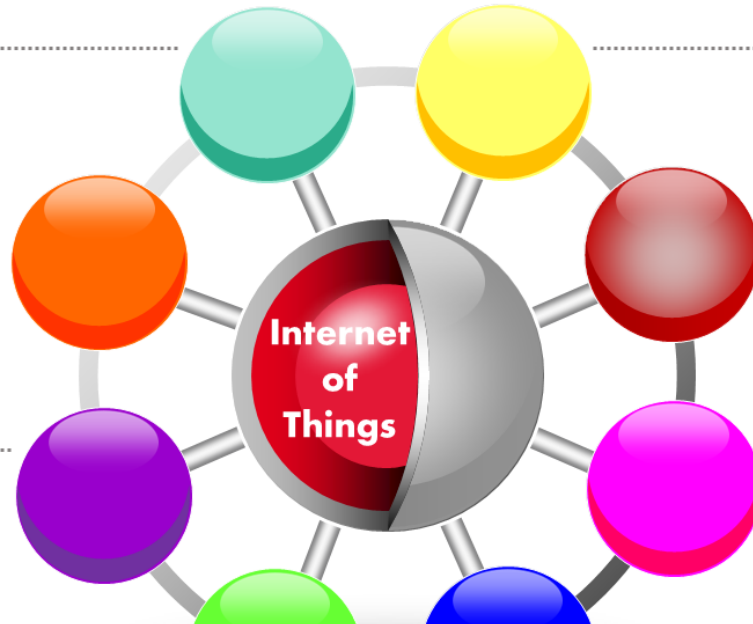
*where physical and virtual "things"*

*have identities, physical attributes, and virtual personalities*

*use intelligent interfaces,*

*and are seamlessly integrated*

*into the information network.*



Connecting:

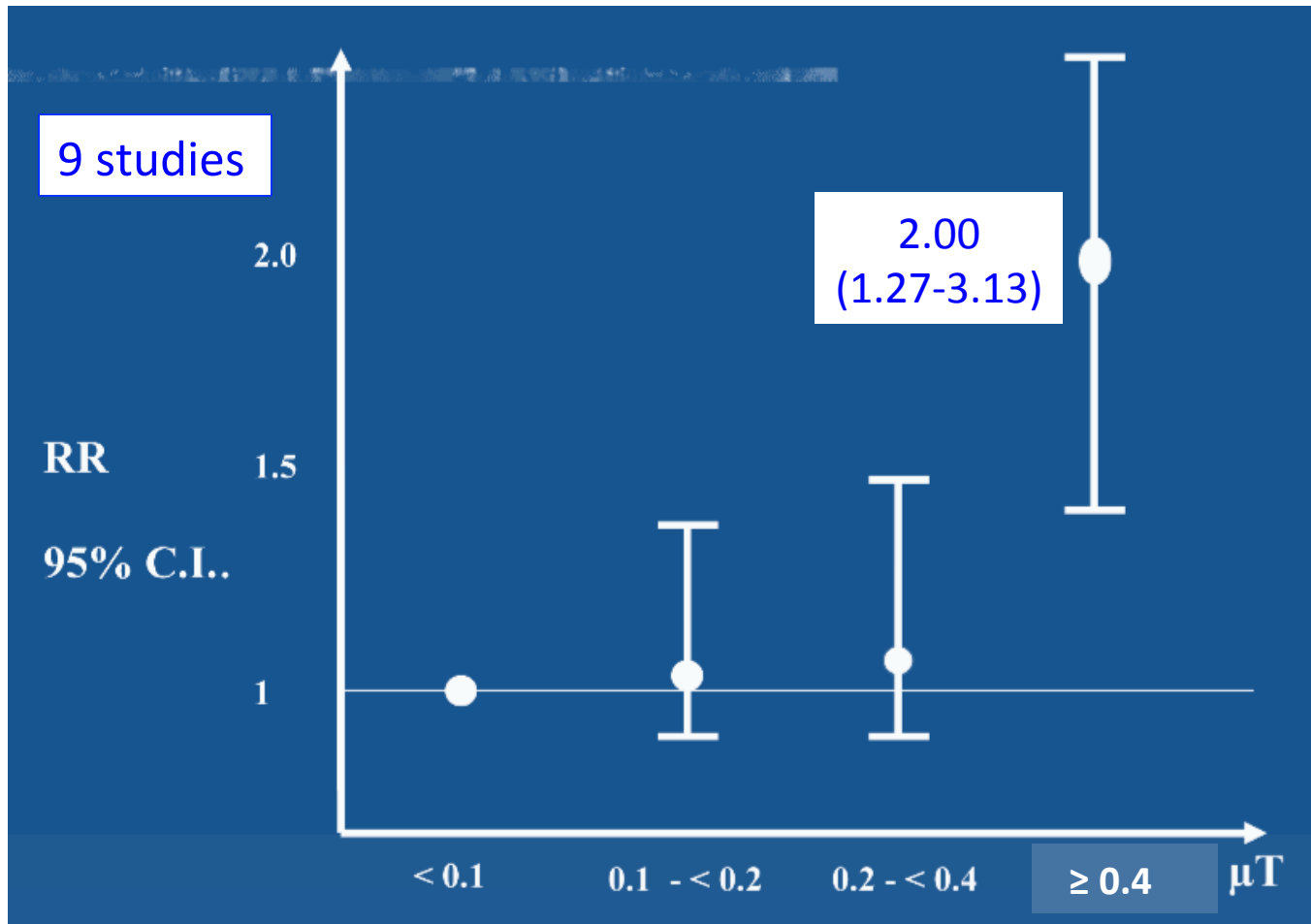
Anything

Anyone

Anytime

Any place  
Any service  
Any network

# Pooled Data Analysis of Power Line Magnetic Fields and Childhood Leukemia



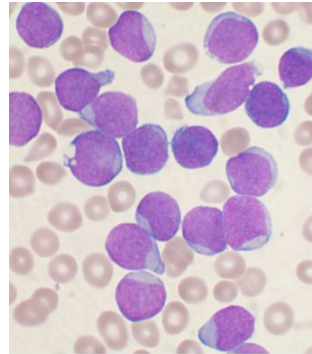
- RR increases with increasing exposure (dose-response)
- When exposure  $\geq 0.4 \mu\text{T}$  (4 mG), RR = 2.0 ('doubling dose')

**Strong evidence for causal association**

# Power Line MFs & Childhood Leukemia



- Power line MFs among most studied environmental factors (42 studies)
- Consistent link: childhood leukemia & power line MF exposures  $\geq 3-4$  mG
- Strong causal relationship as other factors (chance, selection bias) ruled out.



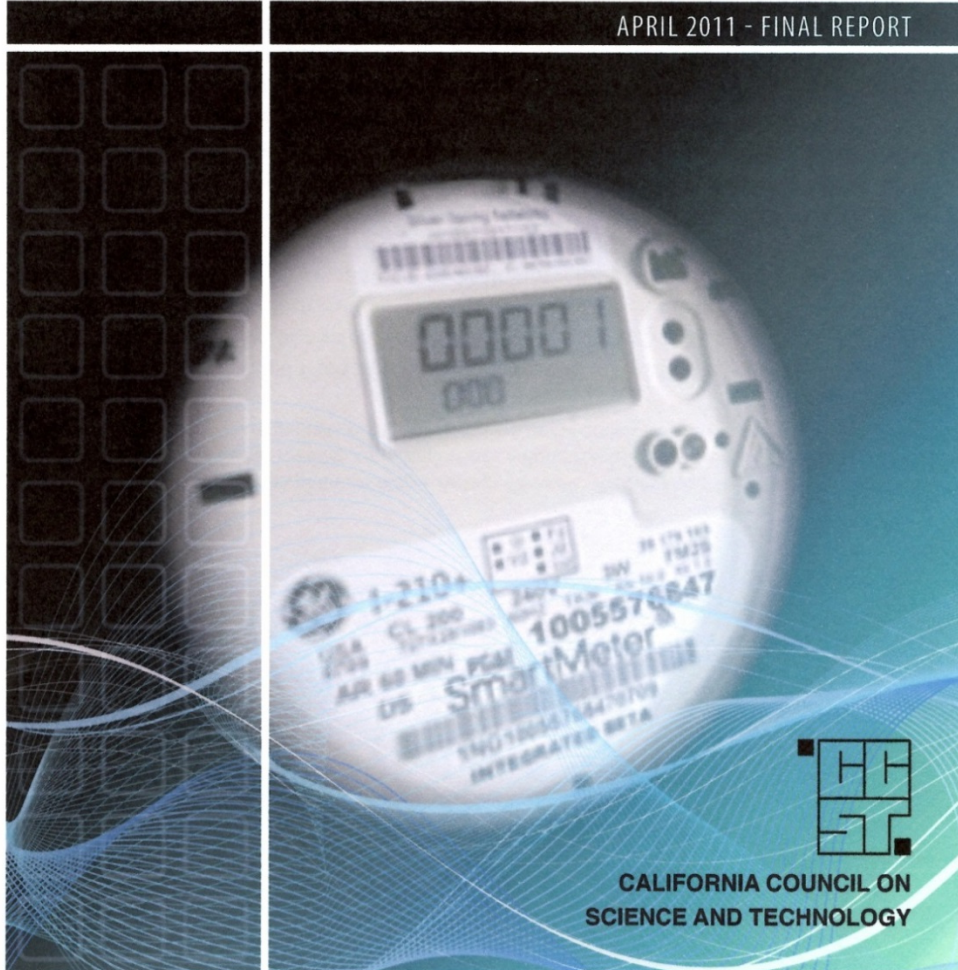
International Agency for Research on Cancer



ELF magnetic fields classified as:  
**Group 2B 'Possibly carcinogenic'**

HEALTH  
IMPACTS OF **RADIO FREQUENCY EXPOSURE**  
FROM **SMART METERS**

APRIL 2011 - FINAL REPORT



- **CCST: appointed advisory panel for state representing industry, university & government interests**

- **Legislative request to perform 'independent, science-based study' to assess whether:**

- 1. National (FCC) standards for smart meters are sufficiently protective of public health**
- 2. Additional technology-specific standards are needed for smart meters ... to adequately protect from adverse health effects.**

**Conclusion: FCC guidelines protective for thermal impacts; non-thermal impacts unknown, further standards not advised.**

Source: California Council on Science & Technology  
[www.ccst.us/publications/2011/2011smart-final.pdf](http://www.ccst.us/publications/2011/2011smart-final.pdf)

# Residential Smart Meter Transmission Frequency in 24-Hour Period

Electric system message type	Transmission frequency per 24-hr period: Average	Transmission frequency per 24-hr period: Maximum (99.9 <sup>th</sup> percentile)
Meter read data <sup>¶</sup>	6	6
Network management	15	30
Time sync	360	360
Mesh network message management <sup>£</sup>	13,000	240,000
Weighted average duty cycle <sup>§</sup>	61.4 sec	1,262 sec

<sup>¶</sup> Billing purposes; 50 msec per transmission

<sup>£</sup> Function in network; 'repeater'; do not emit at same time; transmit randomly

<sup>§</sup> Average 'on air' time for each meter across mesh network

Source: Sacramento Municipal Utility District at [www.smud.org](http://www.smud.org)

# Industry's Position on Smart Meters: Health Threat

**‘So when confronted with complaints that say smart meters cause ... health effects, ask the complainant to produce the science to support the claim. The conversation should end shortly thereafter.’**



**Klaus Bender, PE  
Director of Standards & Engineering  
UTC**

***Source: No Health Threat from Smart Meters in Fourth Quarter 2010 Issue, UTC JOURNAL***

# Bizarro

by Dan Piraro

BIZARRO.COM

Facebook.com/BizarroComics

Dist. by King Features

When you say it is responsible  
for environmental destruction,  
climate change, and the erosion  
of the middle class, it hurts  
Daddy's corporation's feelings.

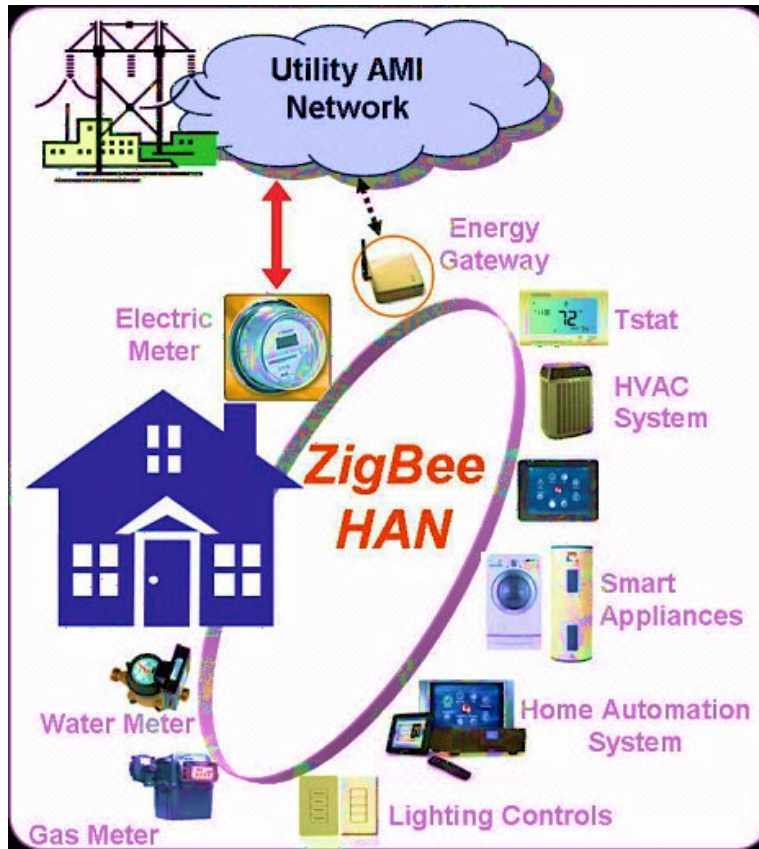




There are three kinds of people:  
Those who make things happen.  
Those who watch things happen.  
Those who wonder what happened.



# Integration of AMI with Home Automation (Utility's Sales Pitch)



**ZigBee®**

Control your world



**ZigBee chip**

**(0.22 W; 2.4 GHz)**

- Dynamic environment to meet resident's needs & lifestyle, conserving energy
- Consolidates & coordinates all home automation activities
- Control & monitoring capabilities with single touch screen
- Detailed usage info to enable load reduction during peak periods.