

BSc Physics, M BioMedical Engineering, PhD in Environmental Science - this allows her to speak about noise, cells & health

- The “Agent of Disease” in infrasound & low frequency noise - pressure waves that come through the air - not constant but varying in time, frequency, vary in time in amplitude
- Pressure is a force/ area
- WHO - def'n: Noise = inanimate mechanical forces
- Noise = any pressure wave that comes through the air is an inanimate mechanical force - which you may or may NOT hear
- The difference between LRN & Noise we hear is the distance between the waves/ peaks
- Low freq - distance between peaks is very large / large wave
- *The Rule of Thumb - the Thickness of the acoustic barrier must be on the order of the wave length
- 20Hz wave length is 17m - acoustic barrier would need to be similar or made with special materials to protect from the wave length
- 1Hz wave length - there is 343m between peaks
- Wavelength of airborne sound at:
 - 3000Hz is 0.11m (4.3“)
 - 500Hz is 0.68m (2'3”)
 - 100Hz is 3.43m (11'3”)
 - 20Hz is 17.1m
 - 1Hz is 343m
- High freq noise, e.g. 3,000Hz - distance between peaks is a small distance in the cm range - would require a barrier of a few cm to provide an acoustic barrier
- Problem with low freq noise - e.g. 20Hz is the limit of hearing so we can't hear it, but with the wave length of 17.1m, it penetrates buildings & the earth, which is why it is a problem for human health
- Infrasound - broken down into ultrasound and low freq (barely audible) - as opposed to vision - e.g. radiation - we recognize a range of “light” wave lengths
- We know historically that loud noise can affect hearing so we protect hearing in that range - within the average hearing range (500Hz-10,000Hz) where we hear the best
- Assumption - wrong (and in Ontario) - that if you can't hear it, it won't hurt you.

- Wrong - we do not have to see the agent of disease for it to harm us - viruses, radiation, etc. dBA - was conceived to protect hearing and it works over 100Hz - but it is inadequate for noise lower than 100Hz
- dBA is scientifically invalid for LFN (percentage of error is very significant)
- near wind farm it is possible to protect hearing by imposing a noise limit of 40dBA - most often below this but not to measure LFN - if LFN is measured using dBA, it is scientifically invalid
- dBLinear (is the NEW accurate measure with a difference of zero in the low freq ranges) - this test reflects the acoustical variations below 100Hz
- This is the way to scientifically quantify the agent of disease
- Anyone who measures LFN and infrasound using dBA units is scientifically invalid
- 2001 Example of similar audible noise sources: a cockpit, a train, a car - revealed similar dBA but measurement of infrasound using dBLinear showed exposure to acoustic energy is different between the 3 noise sources - hear the same dBA but exposed to more acoustic energy depending on noise source & frequencies
- Biology and cells react differently to different frequencies: e.g. lung, liver, tissues respond differently to different frequencies
- Since 2001, new method for measuring noise dBLinear
- IWT's create "acoustic pollution", e.g. mink farm in Denmark, example
- Wind Generator is NOT a wind mill - which depends on sails
- Governments & legislation measure only dBA although anyone is exposed to a lot more acoustic energy - this is not reflected in legislation
- Gov't legislation requires that measurements are taken with noise (turbines turning) and without noise (turbines shut off)
- new measurement technique allows for the measurement of acoustic environment between 0-600sec or 10min, in small increments, creating a photograph
- A clear "pulse" is visible with wind turbines, like a "photo" stopped in time
- The time of the pulse (pulse code) is important for biological response - not noise HEARD but acoustic pollution
- Teams like Dr. Mariana's study the effects of LFN & infrasound wherever they occur: airports, industrial complexes, public transportation - Wind Turbines are the latest/newest area of study for ACOUSTIC POLLUTION
- Not just frequency, not just amplitude in dB's, pulse code is also important for biology
- WT noise is absolutely periodical/ falls exactly on a harmonic series/ mathematical tool - fundamental frequency has to do with the # of blade passes/sec
- Wind does not have a harmonic series nor do ocean waves - this kind of acoustical energy is not in nature - it is mathematical

- dBA not really useful ever, if we want to quantify/analyse what is happening with biology & in presence of LFN
- VIBROACOUSTIC DISEASE: 30 year study started by Dr. Costello Branco, 1980-1986 - Portuguese Airforce Base - wanted to determine how to protect workers - watched one person's bizarre behaviour during "run-up" procedure - walking without purpose twd exhaust/ turbo engine - was told it was not the first time
- Investigation led to diagnosis of late onset epilepsy - later found that 10% of the workers were diagnosed with late onset epilepsy as an adult - normal population rate is 0.2%
- In 1983 death of a worker caused another worker to demand an autopsy when he died - in 1987 Dr. Branco had an opportunity to do the autopsy - found 2 tumours - kidney and brain (silent) - worker had 11 scars in heart tissue below 2mm - abnormal thickening of heart tissue & pulmonary fibrosis - normal pericardium is very thin 0.5mm to 2.3mm in pericardium showing thickening
- Further studies were done on patients recommended for surgery - found no restriction of heart vessels but thickening of pericardium - we can now use echo-cardiogram to check for thickness of pericardium without doing surgery
- *Legislation only measures dBA but science has abandoned this type of measurement because science is interested in the effects of acoustic energy (pollution) on the BIOLOGY
- Thickening also occurs in blood vessels - growth made of collagen & elastin cardiovascular problems due to thickening of arteries not due to cholesterol - collagen & elastin growth - morphogenesis - triggered by exposure of whole body to extraordinary mechanical forces
- Effects are cumulative
- Occupational Exposure - Respiratory - seen in workers - thickening of alveola - scale is the same
- Studies with rats showed trachea effects with exposure to LFN - changes as a result of exposure to noise
- Actin, collagen - ear of rats - showed basal - cilia - tectorial membrane changed/ fused together - ordinarily wave results in movement of cilia which touches tectorial membrane and the message is sent to the nerve
- This could explain the organic basis for people who react with annoyance to noise, following LFN exposure - there are hearing effects in response to LFN
- Different behaviours seen in response to loud noises - avoid them/ situations which may result in exposure - different from someone with gradual, age-related hearing loss who asks for info to be repeated but does not hide from sound/noise or find it painful
- When scientists who were used to aeronautical noise were asked to investigate noise within homes - they were surprised to find that the clinical stages of vibroacoustic disease is accelerated within a home because of the 24/7 exposure - with job-related noise exposure, there is a break from exposure evenings, weekends, etc.

- Infrasound and LFN has been demonstrated to have negative effects on fetuses - e.g. in Australia as a result of mining activities, related to grain-elevators at shipping terminals, etc.