What's in that air you are breathing anyway?

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Indoor Air Pollution

 Outdoor Air Pollution That Infiltrates Indoors
Naturally Occurring and Manmade Indoor Air Pollution

Why worry about indoor air you say? The average American spends >95% of their time indoors!

Outdoor Air Pollution Sources

- Naturally Occurring
 - Pollens
 - Bioaerosols (molds & fungi)
 - Ionizing Radiation (e.g., Radon)
- Man Made
 - Vehicle & Industrial Emissions
 - Photochemical Oxidants (e.g., ozone)
 - Applied Chemicals like Pesticides and Herbicides

Outdoor pollens, molds and fungi

- Pollen from plants and trees
- Outdoor molds & airborne fungi



Credit: www.newtownapple.org.uk

Penetrate through cracks and openings; tracked into homes
Lung irritant; eye irritant; nasal irritant

Close windows during pollen season; seal window and door cracks









moldbacteria.com

robinloznakphotography.blogspot.com

RADON

- Radioactive gas that results from uranium decay. Cannot taste or feel or smell it.
- Short half-life (~3.8 days)
- Migrates into buildings by something called the stack effect warm air rising. Also enters water sources.
- People can inhale the radon while showering using a contaminated water source or when the radon enters a home and grabs on to dust in air.
- People can ingest radon when that dust land on countertops and food preparation areas.
- Radon exposure can result in lung and stomach cancers, with radon being the second leading cause of lung cancer in the United States. (NAS – Health Effects of Exposure to Indoor Radon, 1998)

Sub-slab ventilation to the outdoors mitigates indoor infiltration; aeration or activated carbon to reduce water-borne radon



Credit: www.ecohome.net



Credit: www.detectingdesign.com

Outdoor Air Pollution Sources

- Naturally Occurring
 - Pollens
 - Bioaerosols from natural outdoor sources
 - Radiologics (e.g., Radon)
- Man Made
 - Vehicle & Industrial Emissions
 - Photochemical Oxidants (e.g., ozone)
 - Applied Chemicals like Pesticides and Herbicides

Vehicle & Industrial Emissions

Particulate matter

- Contaminants in the fuels that enter the air as solids.
- Examples are lead and mercury (both affect your neurologic system)
- Can be tracked in to homes. Can infiltrate into homes through cracks and openings.
- Volatile Organic Compounds (VOCs)
 - Chemicals that enter the air as gases.
 - Incomplete burning of gas, coal, oil and garbage.
 - Examples are chlorine and formaldehyde. Can infiltrate into homes through cracks and openings.
 - Lung irritant, toxic materials, and carcinogens





Applied Chemicals

Pesticides, Herbicides, Fertilizers, etc.

- After lawn application, herbicides and fertilizers have been detected in indoor air and on all surfaces throughout the home including countertops and tables.
- Track-in most significant factor for intrusion but the chemicals also become aerosolized and come in through cracks, windows, etc.
- Most of these chemicals are toxic with some being affecting the nervous system used for chemical warfare agents.





Indoor Air Pollution Sources •Naturally Occurring' Pets Pests and Biologics Man Made Human Activities Building Materials Appliances

Animals

- Animals track and resuspend materials in the home; animals shed (hair and skin). Reservoirs include sofas, carpets.
- Can cause asthma or allergy attacks; irritates the lungs and nose and eyes.

Use a HEPA filter vacuum; remove dust from surfaces regularly



Interesting note!

Children raised in a house with two or more dogs or cats during the first year of life may be less likely to develop allergic diseases as compared with children raised without pets!!!!

Reference: DR Ownby et al. Exposure to dogs and cats in the first year of life and risk of allergic sensitization at 6 to 7 years of age. Journal of the American Medical Association 288(8): 963-72 (2002).

Pests & Biologics

 Dust mite (feces)
Viable Mold & Airborne Fungi



Can cause allergic reactions certain molds can cause serious illness e.g., black mold or stachybotrys

- Wash bedding often in hot water
- Keep low humidity in home
- Repair water leaks immediately



Indoor Air Pollution Sources

- Naturally Occurring'
 - Pets
 - Pests and Biologics
- Man Made
 - Human Activities
 - Building Materials
 - Appliances

Human Movement (walking, cleaning, dressing, etc.)

Resuspension of particles from surfaces (including all that nasty stuff you carried in on your shoes!)



- Sloughing of skin flakes
 - food for dust mites
- Human respiration, coughing, sneezing
 - spread viruses and bacteria



Vacuum with a HEPA filtered vacuum regularly, change your furnace/AC filters regularly, take off shoes before entering your home, & cover coughs and sneezes

Cooking



Aerosolization of particles (oil droplets, salts, etc.)

- Chemicals released from Teflon coated cooking surfaces
- Chemicals/carcinogens from chargrilled meats

Flavoring and packaging related chemicals (VOCs) from cooking items such as microwave popcorn, etc.

Ensure good ventilation when cooking (and open your microwave popcorn bag outdoors!)







Releases particles, PCBs, pesticides, and a bunch of other chemicals like formaldehyde and acrolein. Research shows that some vaporizers release up to 31 potentially harmful chemicals, including two possibly cancer-causing compounds, depending on the temperature at which liquids are "vaporized" by the device. Environ. Sci. Technol., 2016, 50 (17), pp 9644–9651

- Spraying air fresheners or personal hygiene products
 - React with ozone to produce micron range particles
 - Release 'numerous' other chemicals into the indoor environment

Do not introduce additional chemicals into your home or workplace

Building Related

Lead – deteriorating paint; residual lead in soils from leaded fuel

May be tracked, resuspended and aerosolized (inhalation and deposition on food surfaces, etc.)

Asbestos - insulation & fireproofing

 Fibers become airborne due to disturbance (moving insulation, breaking shingles or floor tiles) and can be inhaled.

Hire a certified professional to remove these materials or seal them in place





Appliances

- Gas ovens & stoves, hot water heaters & dryers combustion/incomplete combustion pollutants (particle and carbon monoxide)
- Laser printers, copy machines, fax machines VOCs, particules, ozone (O3)

Microwaves, computers, TVs, other plastic-cased appliances – contain brominated flame retardents -found in accumulated dust on these items. Suspected carcinogen, affects the thyroid of cats. (Dye et al, 2007)

Keep appliances well ventilated and remove dust accumulations regularly



THIS IS ALL TOO MUCH – I'M SCARED – WHAT IS THE ONE THING I CAN DO TO MAKE A DIFFERENCE IN MY EXPOSURE TO CHEMICALS IN MY HOME? Resuspension and Tracking of particles primary mode of movement of particle based contaminants indoors, as shown by the anthrax attack on the Hart Senate Office Building.



Stepping or Walking on a Particle Contaminated Surface



- Particles are picked up by the foot surface during uplift.
- Particles falls from the bottom of the foot/shoe surface.
- Rotating motion causes turbulence under the foot.
- Cotton socks pick up significantly more particles than a rubber soled shoe.

Tracking

- Tests showed that between 40-80% of the particle mass on a shoe is transferred to carpet on the first step, with subsequent steps transferring about 2%.
- Approximately 1% of the particle mass in the carpet was transferred to the shoe at each step.

Thus, once stuff is in you house, it gets ALL OVER THE PLACE!









Once those particle are resuspended

Numerous things can happen ...

Can be breathed in by you, your children and your animals (depending on resuspension height)

- Land on surfaces used for food preparation or service (leading to ingestion)
- Land on surfaces where they will again be reaerosolized, potentially into your breathing zone

Take Home Message **TAKE OFF YOUR SHOES BEFORE YOU GO** INDOORS!!!!

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