

The Relationship of Environment and Human Health



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Environmental Toxins Impact Us All



- 80,000 chemicals have been created since WW II; 2,800 are high production volume chemicals that exceed 1 million pounds/year.
- Less than 20% of these chemicals have been tested for their possible toxicity to children.

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Environmental Toxins Impact Us All



- Environmental toxicants are industrial or naturally occurring, organic or inorganic, chemicals that harm human health across the lifespan and more so during critical developmental windows.

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Safe Until Proven Dangerous

- Unlike pharmaceuticals or pesticides, industrial chemicals do not have to be tested before they are put on the market.
- E.P.A. has mandated safety testing for only a small percentage of the 85,000 industrial chemicals in use.
- Once chemicals are in use, the regulatory burden is so high that only five substances have been banned or restricted: polychlorinated biphenyls, dioxin, hexavalent chromium, asbestos and chlorofluorocarbons.

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"All substances are poisons; there is none which is not a poison. The dose differentiates a poison and a remedy."

Paracelsus (1490-1541)

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The First Environment



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Toxins in Umbilical Cord Blood

- 10 newborns –an average 200 industrial chemicals and pollutants
- Of the 287 chemicals detected, 180 cause cancer in humans or animals, 217 are toxic to the brain and nervous system, and 208 cause birth defects or abnormal development in animal tests

Environmental Working Group 2005

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Many of the chemicals identified in the cord blood samples cause irreversible changes in the brains, reproductive systems and other vital organs of fetal and newborn test animals.

- **Bisphenol A**, a hormone-disrupting plastic chemical now under federal scrutiny for a ban in baby bottles, infant formula cans and other food packaging;
- **Perchlorate**, a rocket fuel component and ubiquitous water pollutant that undermines thyroid function crucial to brain development;
- **Polychlorinated biphenyls (PCBs)**, probable human carcinogens and endocrine disruptors effectively banned during the Carter administration, yet still showing up in human and animal tissue worldwide;
- **Lead**, found in older pipes and paint, toxic to the brain and nervous system;
- **Mercury**, another neurotoxin, commonly ingested in contaminated seafood like tuna.

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Pregnancy

- Chemical exposures *in utero* associated with low birth weight, preterm delivery, decreased fetal growth, birth defects, pregnancy loss, and developmental delays.
- While lead levels have markedly decreased, chemicals like DDT and PCBs banned in the 1970's, are still present in a significant portion of the population, including pregnant women.

Stillerman KP, et al. Reproductive Sciences 2008;15 (7): 631-650.
Woodruff TJ, et al. Environ Health Perspect. 2011;119(6):878-885.

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Early Exposures

- *In-utero* and early life exposures contribute to neurodevelopmental disorders at doses much lower than those affecting adult brain function.
- Emerging evidence now linking exposures to manganese, high fluoride levels, certain pesticides and flame retardants with adverse neurodevelopmental outcomes.

Grandjean P, et al. *Lancet* 2014; 330-338

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"In our every deliberation, we must consider the impact of our decisions on the next seven generations."



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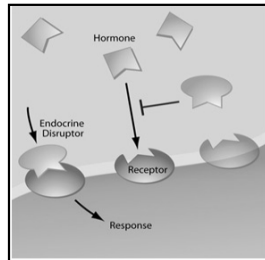
The Environmental History in Pediatric Practice: A Study of Pediatricians' Attitudes, Beliefs, and Practices

- Strongly believe in importance of environmental exposures to children's health. (53.5% had patient seriously affected)
- Fewer than 20% report training in environmental history taking.
- Lack confidence in environmental history-taking, and in discussing environmental exposures with patients.
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- Fewer than 20% report training in environmental history taking. Lack confidence in environmental history-taking, and in discussing environmental exposures with patients.

www.psr.org/resources/pediatric-toolkit.html

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Endocrine Disruptors



Chemicals that may interfere with the body's endocrine system and produce adverse developmental reproductive, neurological, and immune effects in both humans and wildlife.

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Endocrine Society Second Scientific Statement

- EDCs contribute to outcomes related to impaired reproduction, neurodevelopment, thyroid function, metabolism, and increased propensity for hormone-sensitive cancers.
- Unfortunately, it is difficult to directly relate chronic disease burden to exposures in humans. The increased prevalence of such diseases underscores the need to invoke precaution in introducing new (and usually untested) chemicals into the environment.

Gore AC, et al. *Endocr Rev* 2015; 36(6):E1-E150.

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Bisphenol A

- One of highest volume chemicals produced worldwide with > 8 billion pounds/annually.
- Used to manufacture polycarbonate plastics.
- Found at detectable levels in the blood of more than 93% of U.S. population.
- May be major contributing factor to increased incidence of infertility, genital tract abnormalities, obesity, ADHD, prostate and breast cancer observed in European and U.S. human populations over the last 50 years.
- Food and Drug Administration banned BPA in baby bottles and children's cups in June 2012.

Vandenberg, et al. *Environ Health Perspect.* 2010;118(8):1055-70
McGuinn LA, et al. *Environ Res* 2015; 136:381-6.

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Dental Sealants

- Resin-based dental sealants and composites with BPA derivative.
- Researchers examined urinary BPA measurements and oral examination data for 1,001 children aged 6 to 19 years from 2003-2004 NHANES.
- Children with 7 to 42 restorations had mean BPA concentrations 20% higher than those of children with no restorations, this did not reach statistical significance.

McKinney C, et al. *J Am Dent Assoc* 2014 Jul;145(7):745-50.

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Canned Soup

- Researchers at the Harvard School of Public Health found that volunteers consuming one serving of canned soup each day for five days had a more than **1,000% increase** in urinary BPA concentrations compared with when the same individuals consumed fresh soup daily for five days.

Carwile JL, et al. JAMA 2011; 306(20):2218-20.



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Limit Exposure



- Reduce use of canned foods.
- Eat fresh or frozen foods.
- Opt for glass packaging, especially for tomatoes.
- Don't microwave plastic.
- Don't store acidic foods in plastic. Use glass.
- Get rid of old/scratched plastic.
- Use BPA free water bottles.
- Powdered infant formula contains less BPA than liquid canned formula.

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Phthalates

- Phthalates group of chemicals used to make plastics more flexible and harder to break.
- Widely used in polyvinyl chloride plastics (e.g., plastic bags, inflatable toys, blood-storage containers, medical tubing, and children's toys), solvents, and synthetic fragrances.
- CDC found 84% population have six or more phthalates in our system. Women had higher levels of urinary metabolites than men for those phthalates that are used in soaps, body washes, shampoos, cosmetics, and similar personal care products.
- SYNTHETIC fragrances are a significant source of exposure.



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Adverse Health Effects

- Peer-reviewed scientific journals have linked phthalate exposure to serious health effects in children, including early puberty and lower testosterone and sperm counts.
- Systematic review/meta-analysis found exposure to EDCs, including BPA and phthalates, increase risk of type 2 diabetes.
- DEHP in critically ill preterm infants can reach 16 mg/kg/d. Iatrogenic exposure to DEHP metabolites during pediatric intensive care independently and robustly associated with important attention deficit observed in children 4 years after critical illness.

Braun JM, et al. Curr Opin Pediatr 2013; 25(2):247-54.
Song Y, et al. J Diabetes 2015; doi: 10.1111/1753-0407.12325.
J Perinatol 2014; 34(12):892-7.

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Phthalate, Asthma & Allergy

- Epidemiological review found childhood phthalate exposure increased risk of allergic disease and airway inflammation.
- Studies show prenatal exposure associated with increased risk of childhood asthma and food allergies.



Wyatt RM, et al. Environ Health Perspect. 2014;122(10):1141-1146.

Stelmach I, et al. Allergy Asthma Proc 2015; 36(4):72-8.

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Omega 3 and Asthma: Impressive

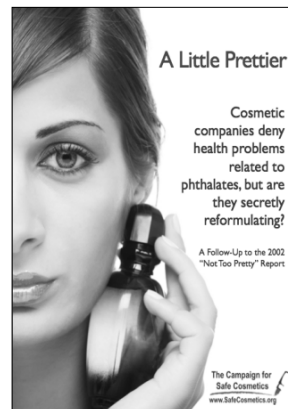
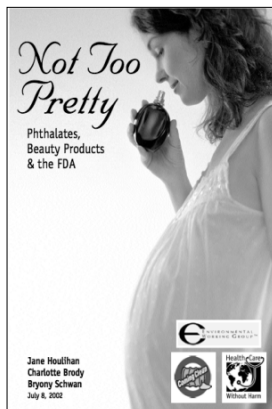
- Reduced intake of omega-3 fatty acids may be a contributing factor to the increasing prevalence of wheezing disorders.
- Reviewers found that supplementation with omega-3 fatty acids in the third trimester of pregnancy **reduced the absolute risk of persistent wheeze or asthma and infections of the lower respiratory tract in offspring by approximately 33%.**



Bisgaard H, et al. N Engl J Med 2016; Dec 29;375(26):2530-9

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Reduce Your Exposure

- OPI, Body Shop, Origins, Burt's Bees and many others do not contain phthalates.
- Be a smart shopper – especially if you are a woman of reproductive age or you are buying products for your child.
- A great website to look up ingredient information is:

www.ewg.org/skindeep/

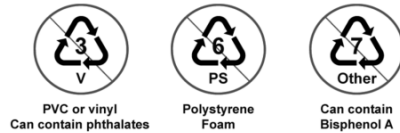
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Choose safer plastics:¹



Plastics to avoid:^{2,3}

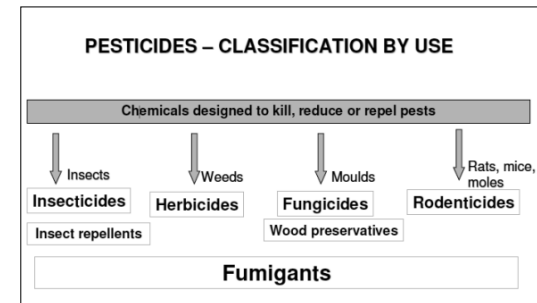


Luz Claudio and Reeve Chace. Quick Guide to Plastics. Staying Healthy in a Changing Environment #3. Mount Sinai Community Health Bulletin.

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Pesticides



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Organophosphates

- Organophosphates first synthesized and used as nerve gas in World War II.
- Their chemical structures and properties significantly modified to alter their toxicity and other physical/chemical properties but they are all neurotoxic. That's how they work as insecticides.
- There is evidence linking neurodegenerative diseases such as Parkinson's disease and Alzheimer's with long-term/low-dose exposure to pesticides such as paraquat, maneb, dieldrin, pyrethroids and organophosphates.

Baltazar MI, et al. Toxicol Lett 2014; 230(2):85-103.

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Pesticide Exposure and ADHD

- Using data from NHANES – children with typical levels of pesticide exposure from eating pesticide-treated fruits/vegetables have higher risk of developing ADHD.
- Children ages 8-15 with higher urinary levels of dimethyl alkylphosphate (DMAP) had twice the odds of ADHD when compared with children with low or undetectable levels.

Kuehn BM. JAMA. 2010 Jul 7;304(1):27-8.

Bouchard, et al. Pediatrics. 2010 Jun;125(6):e1270-7.

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Pesticide and ADHD

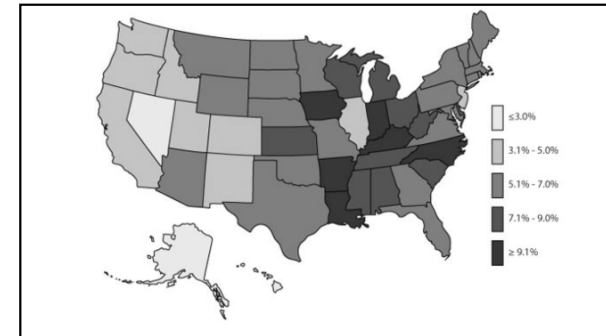
- Pyrethroid pesticides cause abnormalities in dopamine system and produce ADHD phenotype in animal models.
- 687 children (8-15 years of age) evaluated. Those with urinary 3-PBA above limit of detection were 2 x more likely to have ADHD compared with those below LOD.
- Hyperactive-impulsive symptoms increased by 50 % for every 10-fold increase in 3-PBA levels; change in inattention was not significant.

Wagner-Schuman M, et al. Environ Health 2015; May 28;14:44.

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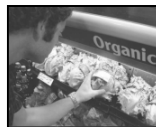
Children on ADHD Medication (2011-12)



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- The consumption of an organic diet for one week significantly reduced OP pesticide exposure in adults as measured by urinary metabolites.
- Total OP metabolites in organic phase were 89% lower than when participants were eating conventional foods.
- Similar results have been shown in children.
- Unfortunately, organic produce is often more expensive than conventionally grown, making it out of reach for some of our most at risk patients.



Oates L, et al. *Environ Res* 2014; 132:105-11
Bradman A, et al. *Environ Health Perspect* 2015; 123(10):1086-93

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www.ewg.org/foodnews/index.php

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STRAWBERRY UPDATE
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FOOD SCORES

DIRTY DOZEN

EWG's 2017 Shopper's Guide to Pesticides in Produce™

1. Strawberries
2. Spinach
3. Nectarines
4. Apples
5. Peaches

More from EWG

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NEW TO LIST: PEARS
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STRAWBERRY UPDATE
[LEARN MORE](#)

FOOD SCORES

CLEAN FIFTEEN

EWG's 2017 Shopper's Guide to Pesticides in Produce™

1. Sweet Corn*
2. Avocados
3. Pineapples
4. Cabbage
5. Onions

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"If we are going to live so intimately with these [agricultural] chemicals--eating and drinking them--taking them into the very marrow of our bones—we had better know something about their nature and their power."



Rachel Carson,
Silent Spring

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Insecticides and Cancer

- Meta-analysis of 16 studies found childhood exposure to indoor residential insecticides associated with a significant increased risk of childhood leukemia and lymphomas.
- Positive but not statistically significant association also found for childhood brain tumors.



Chen M, et al. Pediatrics 2015;
136(4):719-29.

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Integrated Pest Management

- IPM focuses on nontoxic and less toxic methods to control pest problems.
- Benefits include: reducing number of pests, reducing number of pesticide applications, lower cost while protecting human health.
- IPM in schools has been recommended by the USDA, EPA, American Public Health Association, and National PTA.

www.epa.gov/managing-pests-schools/introduction-integrated-pest-management

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Atrazine

- Exposure to even low levels of herbicide atrazine can turn male frogs into females that produce completely viable eggs.
- Atrazine widely used on US corn crops in the United States, and consequently it's a pervasive drinking water contaminant.
- Linked to breast tumors, delayed puberty and increases lymphocyte chromosomal abnormalities.



Mercury

- Bacteria in water can transform inorganic mercury into bio-active, organic form, called methylmercury, which concentrates to very high levels in fish.
- US Geological Survey of 291 freshwater streams between 1998-2005 found 100% of the larger fish tested positive for significant mercury exposure.
- Majority of mercury entering US rivers stems from emissions from coal mining. The emissions enter the air and then are precipitated back into water systems.

Scudder BC, et al. U.S. Geological Survey Scientific Investigations Report 2009-5109, 74 p.

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FDA Advice



- Women of childbearing age and young children:
 - NO swordfish, shark, king mackerel, or tilefish.
 - Eat 12 ounces (340 g) fish and shellfish low in mercury per week.
 - Omega 3 crucial for optimal neurological development in the fetus and infant.
 - Take a prenatal vitamin with DHA.

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Seafood Calculator

www.ewg.org/research/ewg-s-consumer-guide-seafood/seafood-calculator

Calculations are based on 4 oz. serving size

CATEGORY	SPECIES	WEEKLY MERCURY	SUSTAINABILITY	CONCLUSION
 EWG'S BEST BETS! Very High Omega-3s, Low Mercury, Sustainable	SALMON	NaN%	Best Choice: Wild Alaska	⚠️ⓧ⚠️
	SARDINES	NaN%	Best Choice: Pacific	⚠️ⓧ⚠️
	MUSSELS	NaN%	Best Choice: Farmed	⚠️ⓧ⚠️
	RAINBOW TROUT	NaN%	Best Choice: Farmed	⚠️ⓧ⚠️
	ATLANTIC MACKEREL	NaN%	Best Choice: Not Trawled	⚠️ⓧ⚠️

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Perchlorate

- Perchlorate is both a naturally occurring and man-made chemical that is used to produce rocket fuel, fireworks, flares and explosives. Well-known to be higher in environments around military bases.
- Perchlorate blocks iodide uptake into thyroid and decreases production of thyroid hormone.
- CDC study found that more than one third of American women are deficient in iodine, and that for these women, exposure to perchlorate in food or water can cause a significant and dose dependent decline in thyroid hormone levels.

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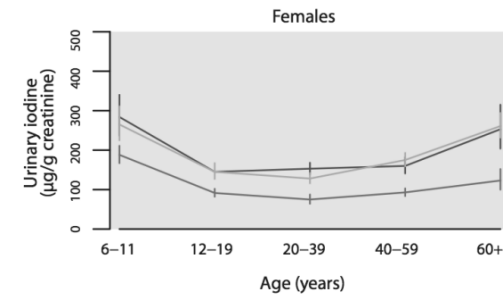
Perchlorate and IQ

- 21,846 women at gestational age <16 weeks recruited in Cardiff, UK and Turin, Italy.
- Urine perchlorate was detectable in all women and iodine levels were low (median 72 µg/L).
- Maternal perchlorate levels in the highest 10% increased odds of offspring IQ being in lowest 10%.
- Maternal thyroid therapy did not reduce the negative impact of perchlorate on offspring IQ.

Taylor PN, et al. J Clin Endocrinol Metab 2014; 99(11):4291-8

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CDC 2nd National Report on Biochemical Indicators of Diet And Nutrition. The WHO recommends that the median UI in pregnancy be 150-249 mcg/L.

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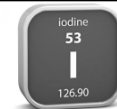
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Iodine

- Iodine deficiency is the most preventable cause of brain damage in the world.
- In 1993, the World Health Organization (WHO) urged that salt iodization be adopted globally.
- Even with this global initiative, iodine deficiency remains one of the main causes of impaired cognitive development in children.
- Roughly 2.3 billion people do not get adequate iodine in their diets.

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Iodine in Pregnancy



- Many reproductive aged women in US have marginal iodine status; only 20% of salt in US contains iodine. Iodine vital to protect against effects of perchlorate.
- Deficiency associated with pregnancy loss and prematurity, cretinism, and neurocognitive defects in the fetus.
- Mild to moderate iodine deficiency associated with higher incidence of ADHD and lower IQ in the baby.
- American Thyroid Association recommends pregnant/lactating women supplement: 150 mcg/d potassium iodide.

Council on Environmental Health, et al. Pediatrics 2014; 133(6):1163-6.

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Food Sources

- Kelp is highest in iodine, while dulse, nori, and wakame contain lower amounts.
- Other food sources include shellfish, fish, cow's milk, and eggs.
- One tsp of iodized salt contains roughly 400 mcg of potassium iodide, but this level may be closer to 240 mcg per teaspoon within 1-2 months after opening the package.

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Additional Suggestions

- Wash and/or peel conventionally grown fruit/veggies (buy organic when possible).
- Wash hands frequently with antibacterial free soap.
- Take shoes off at door, change clothes at work if chemical exposure risk. Launder separately.
- Avoid or use least toxic pesticides on pets.
- Use nontoxic and low VOC materials for art/crafts.
- Monitor Air Quality Index (epa.gov/airnow)
- Choose safer cleaning and personal care products.
- Use hats, protective clothing, physical sunscreens.

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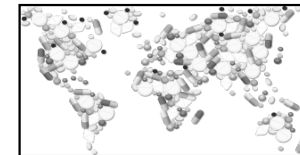
*Knowing is not enough, we must apply.
Willing is not enough, we must do.
Goethe*

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Pharmaceuticals in the Environment

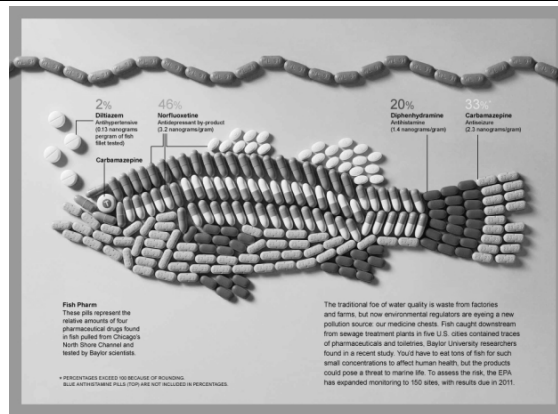
Over 200 different pharmaceutical agents, including antibiotics, NSAIDs, analgesics, lipid-lowering drugs, estrogens, anti-depressants and others, have been detected in aquatic and terrestrial environments around the world, including areas as remote as the Antarctic.



Murdoch K. www.ntn.org.au/wp/wp-content/uploads/2015/05/NTN-Pharmaceutical-Pollution-in-the-Environment-2015-05.pdf Accessed September 12, 2016

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Source: National Geographic Magazine

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Neurodevelopment

- Animal studies suggest that psychoactive pharmaceuticals at environmentally relevant concentrations found in drinking water alter genes that regulate the development and function of the nervous system.
- More research is necessary to determine the impact of drinking water and the potential association of psychoactive meds with neurodevelopmental disorders.

Kaushik G, et al. Biochem Biophys Res Commun 2016; 474(2):291-5.

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Our Epitaph May Read:

"They died of a particular strain of reductionism complicated by a sudden attack of elitism even though there were ready natural cures close at hand."

Gary Nabhan
Cultures of Habitat

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Antibiotics in the Environment

- Antibiotics are among the most successful group of pharmaceuticals used in human and veterinary therapy.
- Large amounts of antibiotics wind up being released into municipal wastewater due to excretion in human waste and/or due to disposal of unused antibiotics.
- Run off of sludge and water from animal feedlots also contribute large amounts of antibiotics into the ecosystem.

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Antibiotic Resistance

- The emergence and rapid spread of antibiotic resistant bacteria (ARB) has led to an increasing concern about the potential environmental and public health risks.
- A 2013 study showed significant correlation between the presence of Antibiotic Resistant Genes (ARG) conferring resistance to macrolides and the composition of bacterial communities, suggesting that antibiotic pollution and the spreading of ARG might play a role in the conformation of bacterial communities in reservoirs.

Bouki C. et al. Detection and fate of antibiotic resistant bacteria in wastewater treatment plants: A review. Ecotoxicology and Environmental Safety, Volume 91, 1 May 2013, Pages 1-9.
Belinda H, et al. Exploring the links between antibiotic occurrence, antibiotic resistance, and bacterial communities in water supply reservoirs. Science of The Total Environment, Volumes 456-457, 1 July 2013, Pages 161-170.

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Global problem

In US, at least 2 million people become infected with antibiotic resistant organisms and 23,000 people die each year as a direct result (CDC)

According to WHO In 2014,

- ~480 000 new cases of multidrug-resistant tuberculosis
- Cambodia-Thailand border, *P. falciparum* has become resistant to almost all available antimalarial medicines
- Some countries, 15% of those starting HIV treatment have drug resistant HIV, up to 40% of those re-starting treatment.

Antibiotic resistance has resulted in what the WHO describes as a major threat to human health globally.

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“The lesson from both our agricultural and medical experience is remarkable for its consistency: Ignoring the evolutionary attributes of biological systems can only be done at the peril of ecological catastrophe.”

Marc Lappe, When Antibiotics Fail

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The Need for More Solutions

- High killing potential of current drugs is one of the strongest sources of selection exerted on pathogens, as evidenced by the rapid and consistent evolution of antibiotic resistance
- In addition to using antibiotics far more judiciously, removing them from non-medical use in animals, and continuing to expand our pipeline (which is running dry) - a broader way of thinking is necessary.
- Exploring natural strategies for enhancing host resistance should be a high priority for both clinicians and researchers.

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"(Our bodies) are not distinct from the bodies of plants and animals, with which we are involved in the cycles of feeding and in the intricate companionships of ecological systems and of the spirit..... It is therefore absurd to approach the subject of health piecemeal with a departmentalized band of specialists... Our fragmentation of this subject cannot be our cure, because it is our disease."

Wendell Berry, The Unsettling of America

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And Another Way of Thinking About Environmental Health



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*Where Would You
Want to Play?*



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*Where Would You
Want to Learn?*

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*Where would you
want to heal?*

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*"Everybody needs beauty as well as bread, places to play in and
pray in, where nature may heal and give strength to body and soul."
John Muir*



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*"Whatever befalls the earth
befalls the sons of the earth.
Man did not weave the web of life:
he is merely a strand in it.
Whatever he does to the web,
he does to himself."*



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