

## Xenobiotics: Endocrine Disrupting Compounds, Pharmaceuticals, and Personal Care Products

One of the hottest topics in environmental circles today is the potential effects of "endocrine disruptors" on aquatic life and human health. Growing concerns by the public over endocrine disruptors have captured the attention of the U.S. Environmental Protection Agency (EPA). A number of studies have confirmed the presence of endocrine disrupting compounds (EDCs) in wastewater in sufficient quantity to cause hormonal changes in aquatic life. EDCs are common in the environment because they are used in every aspect of our society. They can be found in pharmaceuticals, personal care products, industrial by-products, plastics, and pesticides.

### What Is An "Endocrine Disruptor?"

Endocrine disruptors are compounds that can block, mimic, stimulate, or inhibit the production of natural hormones, disrupting the body's natural endocrine system from functioning properly. The endocrine system is a combination of glands and hormones that assist in our reproduction, growth, and development. Endocrine disruption may be described as not necessarily a toxicological end-point, but rather a functional change that may lead to adverse effects. Susceptibility to endocrine disruption is greatest while in the womb, when development is set in motion.

Pharmaceuticals, personal care products (PCPs), pesticides, and plastics are groups of compounds known to contain endocrine disrupting chemicals. More specifically, phthalates (used as plasticizers), alkylphenols (industrial detergents), organochlorine pesticides, polychlorinated biphenyls - or PCBs (used to insulate electrical equipment), dioxins (incineration by-product) and bisphenol A (used in packaging food) are a few of the groups of compounds that have been identified by the EPA as chemicals with hormone disrupting effects.

Although there are some known EDCs, most chemicals are termed 'suspect' because there is not enough data to make a conclusive determination of their endocrine disrupting characteristics. There is a general lack of data that links exposure to low levels of EDCs and adverse effects in humans and/or wildlife. The absence of adequate exposure data, especially exposure data during critical development periods, is the weakest link in determining whether observed adverse effects in humans and/or wildlife are linked to EDCs.

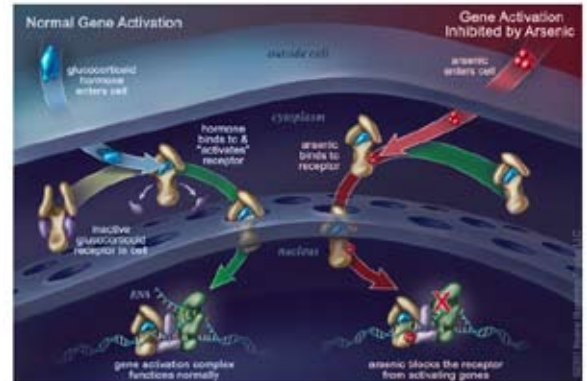


Illustration by William Scavone is reproduced courtesy of Joshua W. Hamilton Ph.D., Center for Environmental Health Sciences, Dartmouth College (<http://www.dartmouth.edu/~cehs/>) and is based on original research reported in: RC Kaltreider, AM Davis, JP Lariviere and JW Hamilton, "Arsenic alters the function of the glucocorticoid receptor as a transcription factor," *Environmental Health Perspectives* 109:245-251, 2001.

*Endocrine disrupting compounds can cause adverse effects. (Center for Environmental Health Sciences at Dartmouth © 2001)*

### Potential Public Health and Environmental Impacts

Adverse effects have been observed in humans when exposed to EDCs. However, cases have only been documented in instances of gross exposure. Endocrine disruptors in the environment have been suspected to decrease sperm counts in males, alter sex hormone ratios, and change mammary development, although human exposure and dose response to EDCs in concentrations at the low levels found in the environment is still unknown.

A recent study conducted by the United States Geological Survey noted the occurrence of EDCs or potential EDCs in surface waters across the country. In the study 139 streams were sampled across 30 states for 95 EDCs or potential EDCs. The streams were selected based on their greater likelihood of contamination. The study found 80 percent of the streams sampled contained at least one of the listed constituents. Although occurrence was relatively high, measured concentrations were low, usually below drinking water standards.

More data exist for impacts to wildlife. The ecological effects have been researched in early studies by Desbrow and Jobling. Research by Desbrow *et al.* has documented the presence of 17-beta ethynyl estradiol (a synthetic hormone used in the birth control pill) in wastewater and suggested that the presence of natural and synthetic estrogen hormones in wastewater has induced female protein production in male

"Dedicated to creative, responsive, quality solutions for those we serve."



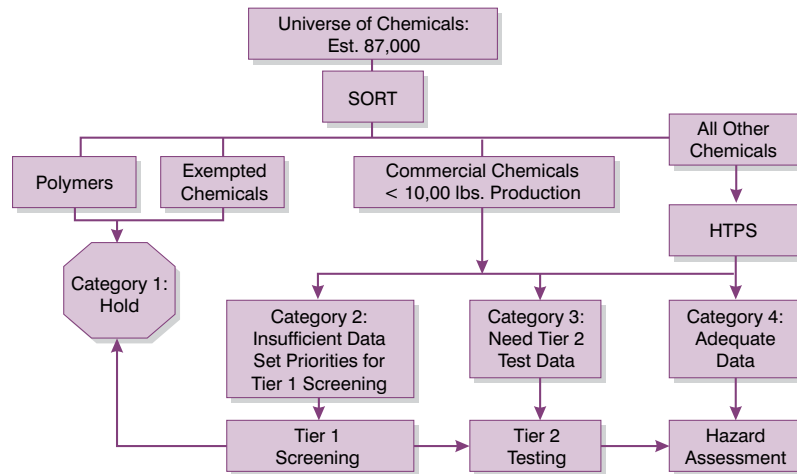
fish. Other research has since confirmed that natural and synthetic estrogens are present in wastewater effluent in sufficient quantity to cause endocrine disruption in fish. Unfortunately, substantive information that identifies and quantifies the compounds of concern is lacking.

### Potential Future Regulatory Actions

Known endocrine disruptors have been banned in the United States (i.e. PCBs, DDT, and chlordane). These chemicals were banned for their carcinogenic effects, not for their estrogenic effects.

European countries are further along in phasing out certain chemicals because of their hormone interference, but this action is not common among governmental agencies worldwide. The World Health Organization's (WHO) recently published document, *Global Assessment of the State-of-the-Science of Endocrine Disruptors (2002)*, concludes that "our current understanding of the effects posed by EDCs to wildlife and humans is incomplete." The approach in the United States has been that more definitive information needs to be gathered and conclusive research conducted before regulatory measures can be taken.

Future regulatory action is likely as research progresses. If so, when EDCs are finally officially identified, it will be necessary to determine effect levels. Those chemicals posing a problem will, most likely, be phased out of use. In the meantime, there is real potential that wastewater treatment facilities will be the target of regulatory control for their releases of these chemicals to the environment.



Endocrine Disruptor Screening Program Overview. EDSTAC Priority-Based Tiered Screening System. Source: Endocrine Disruptor Screening Program: Office of Science Coordination and Policy, US EPA.

### Examples of the Types and Sources of Substances that have been Reported as Potential Endocrine Disrupting Chemicals

Category	Example of Substances	Examples of Uses	Example of Sources
polychlorinated compounds	polychlorinated dioxins, polychlorinated biphenyls	industrial production of by-products (mostly banned)	incineration, landfill
organochlorine pesticides	DDT, dieldrin, lindane	insecticides (many phased out)	agricultural runoff
current use pesticides	atrazine, trifluralin, permethrin	pesticides	agricultural runoff
organotins	tributyltin	antifoulants on ships	harbors
alkylphenolics	nonylphenol	surfactants (and their metabolites)	industrial and municipal effluents
phthalates	dibutyl phthalate, butylbenzyl phthalate	plasticisers	industrial and municipal effluents
sex hormones	17-beta estradiol, estrone	produced naturally by animals	municipal effluents
synthetic steroids	ethynylestradiol	contraceptives	municipal effluents
phytoestrogens	isoflavones, ligands, coumestans	present in plant material	pulp mill effluents

Source: Canadian Wildlife Service, Pacific Wildlife Research Center.