National Institute of Environmental Health Sciences
Your Environment. Your Health.

Endocrine Disruptors and Your Health

Endocrine-disrupting chemicals (EDCs) are natural or human-made chemicals that may mimic, block, or interfere with the body's hormones, which are part of the endocrine system. These chemicals are associated with a wide array of health issues

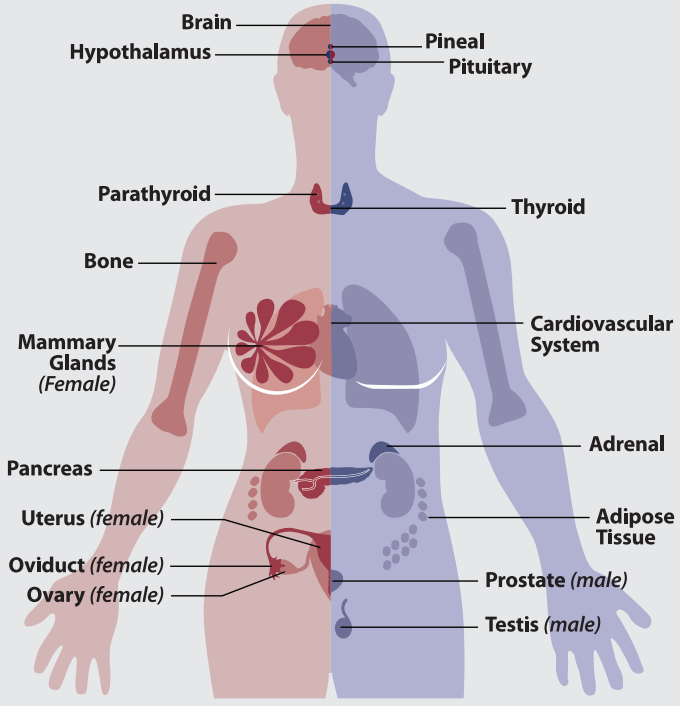
The endocrine system

Endocrine glands, distributed throughout the body, produce the hormones that act as signaling molecules after release into the circulatory system.

The human body is dependent on hormones for a healthy endocrine system, which controls many biological processes like normal growth, fertility, and reproduction.

Hormones act in extremely small amounts, and minor disruptions in those levels may cause significant developmental and biological effects.

Diagram of many of the body's endocrine glands



How do we encounter these chemicals?

Endocrine disruptors are found in many everyday products, including some cosmetics, food and beverage packaging, toys, carpet, and pesticides. Some chemicals that act as flame retardants may also be endocrine disruptors. Contact with these chemicals may occur through air, diet, skin, and water.

EDCs cannot be completely avoided or removed; however, you can make informed choices to reduce exposure and risk of any potential health effects.

Chemicals that may disrupt your endocrine system

According to the Endocrine Society, there are nearly 85,000 human-made chemicals in the world, and 1,000 or more of those could be endocrine disruptors, based on their unique properties.[1] The following are among the most common and well-studied.

Atrazine is one of the most commonly applied herbicides in the world, often used to control weeds in corn, sorghum, and sugarcane crops.

Bisphenol A (BPA) is used to make polycarbonate plastics and epoxy resins. It is used in manufacturing, food packaging, toys, and other applications. BPA resins may be found in the lining of some canned foods and beverages.

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Dioxins are a byproduct of certain manufacturing processes, such as herbicide production and paper bleaching. They can be released into the air from waste burning and wildfires.

Perchlorate is a colorless salt manufactured and used as an industrial chemical to make rockets, explosives, and fireworks, which can be found in some groundwater.

Per- and polyfluoroalkyl substances (PFAS) are a large group of chemicals used widely in industrial applications, such as firefighting foam, nonstick pans, paper, and textile coatings.

Phthalates are a large group of compounds used as liquid plasticizers. They are found in hundreds of products including some food packaging, cosmetics, fragrances, children's toys, and medical device tubing. Cosmetics that may contain phthalates include nail polish, hair spray, aftershave lotion, cleanser, and shampoo.

Phytoestrogens are naturally occurring substances with hormone-like activity found in some plants; they may have a similar effect to estrogen produced by the body. Soy foods, for example, contain phytoestrogens.

Polybrominated diphenyl ethers (PBDE) are used to make flame retardants for products such as furniture foam and carpet.

Polychlorinated biphenyls (PCBs) were used to make electrical equipment, such as transformers, and are in hydraulic fluids, heat transfer fluids, lubricants, and plasticizers. PCBs were mass-produced globally until they were banned in 1979.

Triclosan is an ingredient that was previously added to some antimicrobial and personal care products, like liquid body wash and soaps.

What have scientists determined?

An independent panel of scientific experts convened by NIEHS and the National Toxicology Program (NTP) concluded that there is "credible evidence" that very small amounts of some hormone-like chemicals harmed the organs and bodily functions of test animals.[2] This report is foundational to ongoing research.

In addition, both the Endocrine Society and the European Society of Endocrinology have highlighted "widespread scientific evidence" that exposure to endocrine-disrupting chemicals is harmful to human, animal, and ecological health.[3] Thus, it is important to minimize exposures, identify new EDCs as they emerge, and understand underlying mechanisms to develop interventions.

How do they affect a body?

Researchers have gained insight into how endocrine disruptors influence the endocrine system and alter hormonal functions. Given the variety of chemicals, it is not surprising that they can act in various ways in different parts of the body. Researchers have discovered that endocrine disruptors can:

- Mimic, or partly mimic, naturally occurring hormones in the body like estrogens (female sex hormones), androgens (male sex hormones), and thyroid hormones, potentially leading to overstimulation.
- Bind to a receptor within a cell, like a key within a lock, and block the naturally occurring hormone from performing. The normal signal then fails to occur, and the body does not respond properly. Examples of chemicals that block hormones are anti-estrogens and anti-androgens.
- Interfere or block the way natural hormones, or their receptors, are made or handled in the body, for example, by altering their metabolism in the liver.

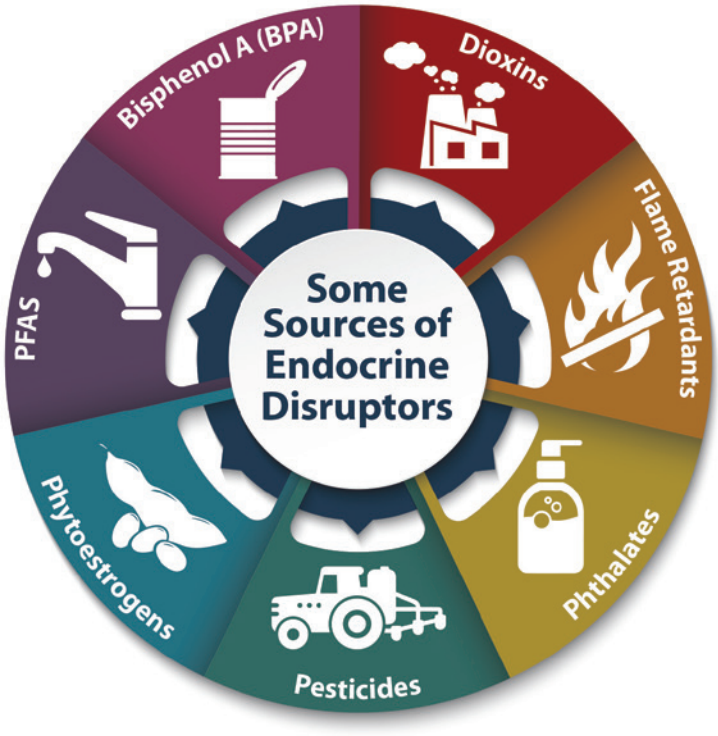
Scientists are not certain how some endocrine disrupters work, and study continues.

Assessing the public health effects of endocrine-disrupting chemicals is difficult for several reasons. People are typically exposed to multiple endocrine disruptors at the same time. Early-life effects of these chemicals may not manifest until much later in life. And, in some cases, these effects can be persistent and be passed down for multiple generations.

What is NIEHS doing?

NIEHS has been a pioneer in supporting and conducting research on the health effects of endocrine disruptors. This research leads to a greater understanding of how endocrine-disrupting chemicals may harm health and cause disease.

Work at NIEHS began with studies on the endocrine-disrupting effects of the drug diethylstilbestrol (DES). From the 1940s through the 1970s, DES was used to treat women with high-risk pregnancies, with the mistaken belief that it prevented miscarriage. In 1972, prenatal exposure to DES was linked to the development of a rare form of vaginal cancer in daughters whose mothers took DES, and with numerous noncancerous changes in both sons and daughters. NIEHS experiments on DES successfully replicated and predicted health problems, which aided discovery of how DES may harm well-being.



Decades later, NIEHS continues work to understand and evaluate potential endocrine disruptors. The goals are identifying key characteristics, understanding both individual chemicals and mixtures, and evaluating potential health effects on humans in the areas of:

- Cancer
- Neurodevelopment
- Obesity and metabolism
- Reproduction
- Thyroid function

Within NIEHS, different programs support innovative research projects on endocrine-disrupting chemicals to uncover how they function and define their role in health and disease. Some areas that these researchers are advancing include:

- Developing new models and tools to better understand how they work.
- Improving ways to identify endocrine-disrupting substances.
- Understanding linkages between exposures and health effects.
- Forming strategies to reduce or prevent exposures.

They also conduct laboratory studies to prioritize endocrine-disrupting chemicals for toxicity testing. NIEHS is developing and applying new ways to use robotics to predict endocrine-disrupting activity for environmental substances. This effort will help spur rapid testing of chemicals to better assess human health effects of environmental exposures.

What have NIEHS and NTP discovered?

Recent NIEHS-supported research shows links between endocrine-disrupting chemicals and the ways in which well-being may be harmed. Examples follow.

Attention. Exposure to certain phthalates was associated with behaviors characteristic of attention deficit hyperactivity disorder (ADHD).[4]

Immunity. Children exposed to high levels of PFAS had a diminished immune response to vaccines.[5] Other research found some indication of increased risks of childhood infections, particularly following exposures to PFAS.[6]

Metabolism. Long-term exposure to arsenic can disrupt metabolism, increasing the risk of diabetes and other metabolic disorders.[7]

Liver disease. A large-scale study on exposure to PFAS in humans and rodents showed consistent evidence of chemical-driven liver damage.[8] Other research indicated that exposure to another endocrine-disrupting chemical, triclosan, worsened fatty liver disease in mice that ate a high-fat diet.[9]

Puberty. Chemicals in lavender oil and tea tree oil were associated with premature breast development in girls,[10] and abnormal breast development in boys.[11]

Reproduction. DES can alter the way genes are turned on and off in reproductive organs of mice, potentially affecting fertility and reproduction.[12] BPA substitutes have also been linked to similar reproductive issues.[13]

For more information on the National Institute of Environmental Health Sciences, visit **https://www.niehs.nih.gov**.

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