

Chemicals and Materials

Endocrine Disruptors

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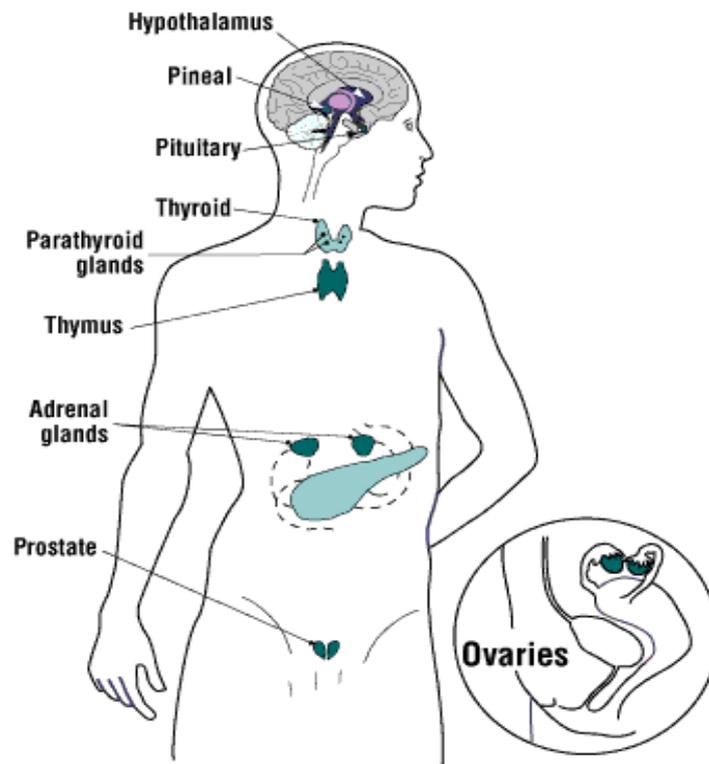
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What is the endocrine system?

The endocrine system consists of a series of organs. The classical endocrine organs in the body are:

- the brain,
- gonads (ovaries and testes),
- thyroid,
- pancreas, and
- adrenal glands



How does the endocrine system function and why is it important?

The endocrine glands release certain chemicals called hormones. Hormones (so-called "chemical messengers") produced by endocrine glands enter the capillaries (and lymph vessels) of the blood circulatory system. They travel through the bloodstream to specific "receptors" in target organs or systems where they can trigger their biological effects.

What are some examples of hormones?

Some examples of hormones released by the endocrine system are:

- ACTH (adrenocorticotrophic hormone) - produced by the pituitary gland to influence the release of corticosteroid hormones from the adrenal glands.
- ADH (anti-diuretic hormone, vasopressin) - produced by the pituitary gland to stimulate water reabsorption by the kidney tubules.
- Adrenaline (epinephrine) and noradrenaline (norepinephrine) - two hormones formed in the adrenal gland that help the body to react (e.g., flight or fight, body defense mechanisms) under stressful conditions (they can increase the heart rate, blood pressure, blood sugar levels, blood clotting rate).
- Estrogen - a female sex hormone produced by the ovaries.

- Testosterone - a male sex hormone produced by the testes, ovaries, and adrenal glands.
 - Insulin - secreted by the pancreas and regulates the storage and use of carbohydrates in the body.
 - Thyroid hormone - produced in the thyroid and influences the function of virtually every cell in the body (growth, development and metabolism).
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Why should we be concerned about the endocrine system?

The endocrine system is important because it coordinates and regulates many essential body functions such as:

- Growth and maturation.
- Behaviour.
- Reproduction and embryo development.
- Production, use and storage of energy.
- Balance and maintenance of water and salt (electrolytes) in the body.
- Reaction to stimuli (e.g., fright, excitement).

The endocrine system controls many functions of the body, both immediate reactions and life-long functions. The hormones stabilize or balance functions in the normal body. In turn, the levels of hormones produced in the body are influenced:

- by stimuli the body receives and
- are regulated by complex biological feedback systems.

Any disruption to this balance can cause changes in the reproduction, development, growth, or behaviour that can affect an animal or human or their offspring or children.

When there is interference with the normal communication between the "messenger" hormone and the cell receptors:

- the chemical message is misinterpreted and
- an abnormal response is generated in the body.

Understanding the role of the endocrine system (and the hormones that they produce) in the normal functioning of the body gives us some indication of the types of problems that might occur when endocrine function is disrupted. Many of these organs influence each other's activities, producing very complex interactions and making the effect of the disruptors exceedingly difficult to identify or predict.

How can the normal communication of the endocrine system be disrupted?

When the endocrine system is exposed to some substances, it may interact with them. These substances are referred to as “endocrine active substances”. When the interaction between the substance and endocrine system leads to “adverse effects”, the substances are called “endocrine disruptors”.

Endocrine disrupting substances interfere with the normal function of endocrine systems in a number of ways:

1. They can mimic a natural hormone and lock onto a receptor within the cell. The disruptor may give a signal stronger than the natural hormone, or a signal that occurs at the "wrong" time.
2. They can bind to a receptor within a cell and thus prevent the correct hormone from binding. The normal signal then fails to occur and the body fails to respond properly.
3. The disruptors can interfere or block the way natural hormones and receptors are made or controlled.
4. Interference with clearance of the hormone

If a substance stimulates or inhibits the endocrine system, then increased or decreased amounts of hormone may be produced. In addition, small amounts of different endocrine disruptor chemicals may have a cumulative effect. In some cases, the by-products of the chemicals may have a greater harmful effect than the parent chemical.

What kinds of substances can be endocrine disruptors?

The number of substances believed to act as endocrine disruptors is wide and varied. They can be natural and synthetic materials. For example:

- Some chemicals in plants (phytoestrogens) have estrogen-like effects.
- Certain drugs and environmental pollutants can either mimic or block the actions of some hormones.

Many plants and animals produce substances that can have endocrine effects. Some of the substances are toxic but certain effects have proven beneficial in some circumstances. For example, some "endocrine disruptors" have been used to:

- control fertility (birth control pills),
- to treat cancer (corticosteroids), and
- to treat psychiatric disorders and other medical conditions.

Natural substances, such as sex hormones or phytoestrogens (plant chemicals having estrogen-like effects), can become concentrated in industrial, agricultural, and municipal wastes. Exposure to these wastes may produce reactions in humans, wildlife, fish, or birds.

Endocrine disruptors are found also in synthetic chemicals used as industrial solvents, lubricants, and their byproducts.

Where are endocrine disruptors often found and what are some examples?

Synthetic chemicals suspected as endocrine disruptors may reach humans and animals in a variety of ways. Some, such as pesticides, are released intentionally. Others are by-products of industrial processes and waste disposal - these include dioxins and PCBs - or are discharged from industrial or municipal treatment systems (See Table below)

The table lists examples of sources, examples of the type of substances with endocrine-disrupting properties that could be present at the source, and the chemical group or type of product these substances belong to.

Sources of potential endocrine disrupters	Chemical group or type of product the substances belong to:	Examples of Substances with potential endocrine disrupting properties that could be present to at the Source
Incineration, landfill	Polychlorinated Compounds (from industrial production or by-products of mostly banned substances)	Polychlorinated dioxins, polychlorinated biphenyls
Agricultural runoff / Atmospheric transport	Organochlorine Pesticides (found in insecticides, many now phased out)	DDT, dieldrin, lindane
Agricultural runoff	Pesticides currently in use	Atrazine, trifluralin, permethrin
Harbours	Organotins (found in antifoulants used to paint the hulls of ships)	Tributyltin
Industrial and municipal effluents	Alkylphenols (Surfactants - certain kinds of detergents used for removing oil - and their metabolites)	Nonylphenol
Industrial effluent	Phthalates (found in plasticizers)	Dibutyl phthalate, butylbenzyl phthalate
Municipal effluent Agricultural runoff	Natural Hormones (Produced naturally by animals); synthetic steroids (found in contraceptives)	Estradiol, estrone, and testosterone; ethynyl estradiol
Pulp mill effluents	Phytoestrogens (found in plant material)	Isoflavones, lignans, coumestans
Consumer products	Cosmetics, personal care products, cleaners, plastics	Parabens, phthalates, glycol ethers, fragrances, cyclosiloxanes, bisphenol A (BPA)

(Source: Endocrine Disruptors Update, 2000, Environment Canada, and Endocrine Disruptors and Asthma-Associated Chemicals in Consumer Products. R.E. Dodson, M. Nishioka, L.J. Standley, et al. (2012). « Environment Health Perspective ». Vol. 120, No. 7, pages 935-943)

What are some possible health effects from exposure to endocrine disruptors?

The most prominent and well documented health concerns from exposure to endocrine disruptors are reproductive and developmental effects. Some of the disorders that have been seen in animal studies include:

- Oligospermia (low sperm count), testicular cancer, and prostate hyperplasia in adult males.
- Vaginal adenocarcinoma, disorders of ovulation, breast cancer, and uterine fibroids in adult females.

Disruption to thyroid functions, obesity, bone metabolism and diabetes are also linked to exposure to endocrine disruptors.

Are endocrine disrupting substances regulated under the WHMIS Regulation?

No WHMIS health hazard class directly identifies endocrine disruptors. Endocrine disruptors that cause other health effects may be identified by the appropriate WHMIS health hazard classes.

What are the employer's responsibilities for protecting workers from endocrine-disrupting substances?

If workers can be exposed to endocrine-disrupting substances, the employer should:

- Have a competent person prepare safe operating procedures (SOP) or safe work practices (SWP). Consult with the manufacturer for technical assistance. The SOP or SWP should include information on:
 - WHMIS requirements (e.g., workplace labels, etc.)
 - Any national, provincial, and municipal environmental regulations that may place any restrictions on their use
 - The safe use, handling, and storage for each product used
 - Waste clean-up instructions for small and large spills
 - First aid
 - Emergency procedures
 - Other applicable information
- Make sure workers are educated and trained to work with the products safely

- If personal protective equipment (PPE) is required, then:
 - Train the workers in the selection, fit, use and maintenance
 - Provide the necessary PPE and make sure workers use them
 - Implement the necessary control measures. Please see the OSH Answers on [Hazard Control](#) for more information
 - If it is not possible to eliminate the use of the hazardous product in your workplace, evaluate whether it is possible to [substitute](#) it with a less hazardous product
 - Minimize the amount of the products that are used (if possible)
 - Ensure the correct fire extinguisher is available
 - Ensure the appropriate equipment for spill clean-up is readily available
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What are the worker's duties when working with endocrine-disrupting substances?

Before you handle endocrine-disrupting substances, make sure you have received:

- Education and training about [WHMIS](#)
- Training covering the Safe Operating Procedures (SOP) or Safe Working Procedures (SWP).
- The SOP or SWP will contain information on:
 - The safe use of these substances (such as those tips in the OSH Answers "[How to work safely with...](#) ")
 - What to do:
 - In emergencies (e.g., fire)
 - If you spill the product
 - With waste product
 - Training on use and maintenance if PPE is required Education about any environmental regulations to the extent they relate to your responsibilities

Only use a hazardous product after you have been trained. Make sure you understand how to use, handle, and store it safely. If you have not been trained, let your supervisor know. If you don't understand the instructions or need help, ask your supervisor.

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