

## The Why Files

### Treatment defeats phony hormones!

Photo: [Delaware County, NY SWCD](#)

Fathead minnows were used to test the feminizing effects of sewage effluent.

The endocrine system is a marvel of subtlety and complexity. Through the life of the animal (human or otherwise), waves of hormones control reproduction, development, behavior, even other hormones. What happens when this natural system gets bollixed up? We've known for decades that endocrine disruptors sourced in pesticides and plastics can operate at the parts-per-billion level. Disruptors in common body-care products ranging from birth-control pills to shampoo are washing down toilets and drains, then causing deformations in the animals that live downstream. In 2006, for example, David Norris of the University of Colorado caged fathead minnows in the outflow from Boulder's wastewater treatment plant. Within seven days, adult males were "feminized," showing female anatomy and behavior. Water leaving the treatment plant contained a regular toiletful of hormonally active crud, including ethinylestradiol, a chemical used in most contraceptives, and natural estrogens made and excreted by people. Other endocrine disruptors in the water included two common plastic compounds, bisphenyl A and phthalates. Detergents and pesticides had contributed (is that the right word?) a further group of endocrine suspects called nonylphenols.

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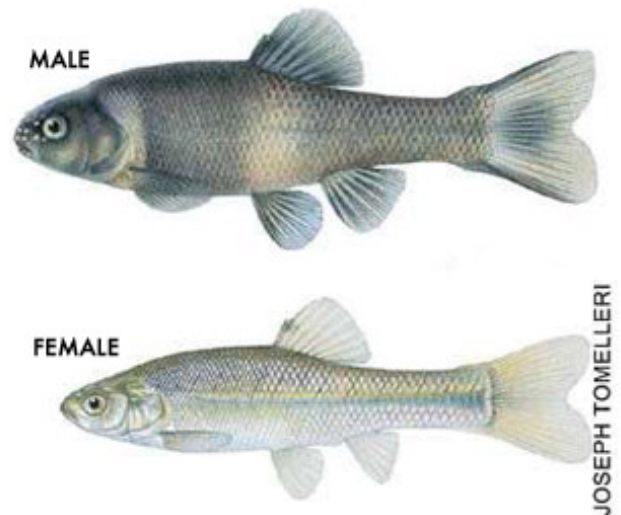


Diagram courtesy [Renewable Water Resources](#)

## Hormones run amok

To compare their ability to trigger the estrogen receptor on cells, estrogen disruptors are measured in units called estradiol equivalents per liter. In 2006, Boulder Creek contained 30 to 40 units, most of it artificial, Norris says. A few trillionths of a gram in a liter of water may not sound like much, Norris realizes. "At first, people thought, 'That's such a small quantity, it can't be meaningful,' but biological systems can see it and respond to it. In lab studies, as little as 1 estradiol unit is enough to feminize a fish, so there was plenty of stuff there."

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Image courtesy [Alan Vajda](#), University of Colorado Denver

A mobile fish lab on Boulder Creek, Colorado, helped researchers assess the effects of endocrine-disrupting pollutants on fish. All the estrogens, artificial and natural, work through same receptor, he says, "so the effects are additive. Even if any single one is not high enough, they add up."

## Ending the endocrine monster?

After the 2006 study (and for reasons unrelated to hormone disruption), Boulder's treatment plant was upgraded. The newly installed "activated sludge process" transfers most of the estrogen disruptors from the liquid to the solid material, called sludge or biosolid, that remains after treatment. "Bacteria are eating the estrogen disruptors to some extent, but the vast majority of the chemicals that come into the sewer are trapped in the biosolids," says Norris. "It's not a mechanism that was planned to deal with these chemicals at these concentrations, but the procedures are pretty efficient at getting the endocrine disruptors out of the water."

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Image courtesy [Lynn Szudy](#)

Aeration tanks at the Madison, Wis. sewerage district are part of a multi-step process that detoxifies sewage and breaks down many of its noxious components. For the study he just presented at the Endocrine Society, Norris repeated his 2006 study, and found no feminization in fish after 28 days, even among fish that lived in pure treated wastewater. That finding accords with tests performed at the Wisconsin State Laboratory of Hygiene, says Jocelyn Hemming, a research environmental toxicologist at the lab. "Activated sludge really helps a lot," she says. In tests using both ultra-sensitive chemical analysis and living cells, "there was definitely good removal of endocrine disruptors, although it wasn't complete at all facilities."



Photo: [Strollerderby](#)

Birth control pills are one source of endocrine disruptors in our waterways, but naturally excreted hormones also play a role. The activated sludge process did transfer some unwanted hormone to the sludge, but Hemming says the bacteria likely ate some of the troublesome compounds. "I think there is a pretty good chance of destruction from the microbial community in the activated sludge; it would not all go into the solids." In Boulder, the chemists are not ready to release the numbers, but "preliminary chemistry shows that the levels of endocrine disruptors in the effluent have gone way down," Norris says. "When you are dealing with nanograms per liter [parts per trillion, by weight], you have to be really careful." Most of the endocrine disruptors in the Boulder sewer system are artificial, Norris says, coming from plastics, solvents and drugs. About 5 percent comes from birth control pills, and about 10 percent is natural, human estrogen.



– David Tenenbaum

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