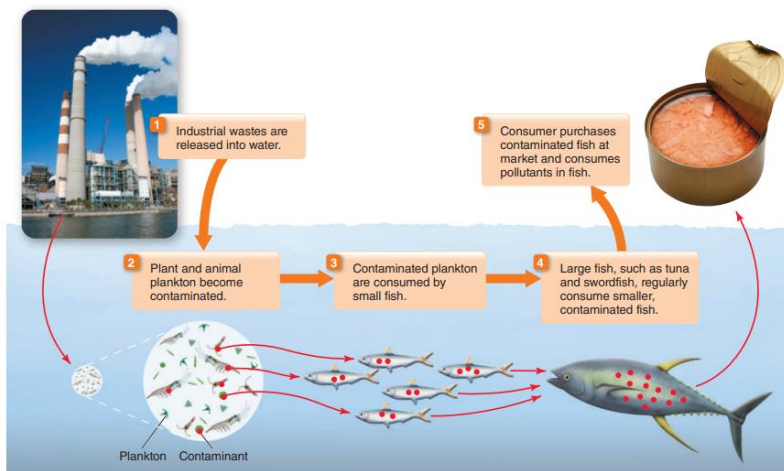


Reading material for the Lesson 2: Unfavorable environmental factors and nutrigenomics. Chemical fertilizers, herbicides, pesticides.chemical fertilizers

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Food residues are chemicals that remain in foods despite cleaning and processing. Residues of global concern include persistent organic pollutants, pesticides, and the hormones and antibiotics used in animals. The health concerns related to residues include nerve damage, disorders of the reproductive system, cancer, and the development of antibiotic-resistant pathogenic bacteria.

Persistent Organic Pollutants Can Cause Illness

Some chemicals released into the atmosphere as a result of industry, agriculture, automobile emissions, and improper waste disposal can persist in soil or water for years or even decades. These chemicals, collectively referred to as persistent organic pollutants (POPs), can travel thousands of miles in gases or as airborne particles, in rain, snow, rivers, and oceans, eventually entering the food supply through the soil or water.²⁴ If a pollutant gets into the soil, a plant can absorb the

chemical into its structure and pass it on as part of the food chain. Animals can also absorb the pollutant into their tissues or consume it when feeding on plants growing in the polluted soil. Fat-soluble pollutants are especially problematic, as they tend to accumulate in the animal's body tissues in ever-greater concentrations as they move up the food chain. This process is called biomagnification. The POPs are then absorbed by humans when the animal is used as a food source

POP residues have been found in virtually all categories of foods, including baked goods, fruit, vegetables, meat, poultry, fish, and dairy products. Significant levels have been detected all over the Earth, even in pristine regions of the Arctic thousands of miles from any known source.

Health Risks of POPs

POPs are a health concern because of their range of harmful effects on the body. Some are neurotoxins. Many others are carcinogens. Still others act as endocrine disruptors, chemicals thought to interfere with the body's endocrine glands and their production of hormones. As you know, hormones play roles in a vast number of body processes, but endocrine disruptors are particularly associated with developmental problems, reproductive system disorders, nerve disorders, and impaired immune function.²⁷ They disrupt normal body processes by blocking the binding sites for natural hormones on body cells; mimicking natural hormones and thereby augmenting their actions; or altering the synthesis or metabolism of natural hormones.²⁷ Some pesticides leave residues that qualify as POPs. These include DDT, a pesticide banned in phases between 1969 and 1972 but still present in the environment.²⁴ DDT and certain other pesticides can act as neurotoxins, carcinogens, and endocrine disruptors.

Heavy Metals

Mercury, a naturally occurring heavy metal element, is found in soil, rocks, and water. It is also released into the air by pulp and paper processing and the burning of garbage and fossil fuels. As mercury falls from the air, it finds its way to streams, rivers, lakes, and the ocean, where it accumulates. Fish absorb mercury as they feed on aquatic organisms, and this mercury is passed on to us when we consume the fish. As mercury accumulates in the body, it has a toxic effect on the nervous system, prompting memory loss and mood swings, as well as impaired vision, hearing, speech, and movement. Large predatory fish, such as swordfish, shark, king mackerel, and tilefish, tend to contain the highest levels of mercury

Lead is another heavy metal of concern. It can be found naturally in the soil, water, and air, but also occurs as industrial waste from leaded gasoline, lead-based








paints, and lead-soldered cans, now outlawed but decomposing in landfills. Older homes may have high levels of lead paint dust, or the lead paint may be peeling in chips, which young children may put in their mouths. Some old ceramic mugs and other dishes are fired with lead-based glaze, allowing residues to build up in foods. No amount of lead is safe. Exposure can cause decreased IQ, serious learning and behavioral disorders, and hearing impairment in children and decreased fertility, nerve disorders, and cardiovascular and kidney disease in adults.

Plasticizers

Chemicals added to paint, varnish, cements, and plastics to increase their workability are collectively known as plasticizers. Two plasticizers found in plastic food containers can leach into foods and act as endocrine disruptors. A chemical called **bisphenol A (BPA)** is routinely used in the linings of canned foods and in some plastic food packaging. BPA is a form of synthetic estrogen, a female reproductive hormone, and research has linked it to genital abnormalities, breast and prostate cancer, miscarriage, reduced sperm count, hypertension and heart disease, and even diabetes. **Phthalates** are a large group of plasticizers that are found in plastic food packaging, shampoos, carpeting and vinyl flooring, pesticides, and many other products. They're also found in dairy products, meats, and drinking water. Phthalates have been linked to reproductive-system and developmental disorders, especially in male infants, shortened pregnancy, and reduced sperm quality in men.

Classification of plastics: what do the marks mean?

Plastic is not just plastic. In order to differentiate between the different types, which is important for collection and recycling, there is a standardized plastics classification. This abbreviation designates the main plastic in the product. For example, PET stands for polyethylene terephthalate and PVC for polyvinyl chloride. There is also a number from 1 to 7 in a triangle of arrows. You will find the plastic classification consisting of code and abbreviation on the underside or the bottom of the packaging.

						
PETE Polyethylene Terephthalate	HDPE High-Density Polyethylene	PVC Polyvinyl Chloride	LDPE Low-Density Polyethylene	PP Polypropylene	PS Polystyrene	OTHER
Common Products: • water bottles • soda bottles • peanut butter jars	Common Products: • milk jugs • 5 gal buckets • shampoo bottles • laundry detergent containers	Common Products: • vinyl • tubing/pipe • siding • auto product bottles	Common Products: • laundry baskets • bread bags • squeeze bottles • plastic film	Common Products: • yogurt containers • amber-colored pill bottles • coffee cup lids • straws • kitty litter buckets	Common Products: • styrofoam cups • solo cups • to-go containers	Common Products: • toys • sippy cups • cd/dvds • lenses

Here are some recommendations for consumers who want to limit their exposure to BPA and phthalates:

- Reduce your consumption of canned foods.
- Avoid purchasing food in plastic containers with the recycling codes 3 or 7. These plastics may contain BPA or phthalates.
- Do not microwave foods in these containers or use them to hold hot foods or beverages. They are more likely to leach endocrine disruptors when they become heated.
- Whenever possible, choose glass, porcelain, or stainless steel containers.

Dioxins are both carcinogens and endocrine disruptors. These industrial pollutants are typically formed as a result of combustion processes, such as waste incineration or the burning of wood, coal, or oil. Dioxins enter the soil and can persist in the environment for many years. There is concern that long-term exposure to dioxins can result in an increased risk for cancer, heart disease, diabetes, reproductive system disorders, and other disorders.³¹ Because dioxins easily accumulate in the fatty tissues of animals, most dioxin exposure in humans occurs through dietary intake of animal fats.³¹ To reduce your exposure to dioxins, eat meat less frequently, trim the fat from the meats you consume, and avoid fatty meats. Choose nonfat milk and yogurt, and low-fat cheeses, and replace butter with plant oils.

Polyfluorinated Chemicals

Concern has also been increasing about persistent residues from poly- and perfluoroalkyl substances (PFASs) that degrade very slowly and have been found all over the globe, including in the tissues of animals and humans. PFASs are used to limit leaking and staining in many commercial products, including *pizza boxes*, *fast food wrappers*, and *microwave popcorn bags*. They have been associated with organ damage, cancer, endocrine disorders, and other health problems.

Pesticides are a family of chemicals used in both fields and farm storage areas to decrease the destruction and crop losses caused by weeds, animals, insects, and fungi and other microorganisms. They increase overall crop yield and allow for greater crop diversity.

The three most common types of pesticides used in food production are

- herbicides, which are used to control weeds and other unwanted plant growth;
- insecticides, which are used to control insects that can infest crops;
- fungicides, which are used to control plant-destroying fungal growth.

Some pesticides used today have a low impact on the environment and are not considered harmful to human health. These include biopesticides, which are species-specific and work to suppress a pest's population, not eliminate it. For example, pheromones are a biopesticide that disrupts insect mating by attracting males into traps. Biopesticides also do not leave residues on crops—most degrade rapidly and are easily washed away with water.

In contrast, pesticides made from petroleum-based products can persist in the environment, polluting soils, water, plants, and animals. They can also harm agricultural workers and consumers, acting as neurotoxins, carcinogens, and endocrine disruptors. In 2015, the World Health Organization's International Agency for Research on Cancer classified the herbicide glyphosate (commonly known as Roundup) and the insecticides *malathion* and *diazinon* as probable carcinogens. Moreover, the 2014 update of the Agricultural Health Study, a joint effort of the National Cancer Institute, EPA, and other federal agencies, found a link between certain pesticides and an increased risk for an aggressive form of prostate cancer. In 2012, the American Academy of Pediatrics published a report describing the harmful effects of pesticides on children, including pediatric

cancers, decreased cognitive function, and behavioral problems, and recommending that families strictly limit their exposure. The EPA is responsible for regulating the labeling, sale, distribution, use, and disposal of all pesticides in the United States. Before a pesticide can be accepted by the EPA for use, it must be determined that it performs its intended function with minimal impact to the environment. Once the EPA has certified a pesticide, states can set their own regulations for its use.

Recommendation

The EPA offers the following strategies for reducing your level of exposure to pesticides.

- Wash and scrub all fresh fruits and vegetables thoroughly under running water.
- Peel fruits and vegetables whenever possible, and discard the outer leaves of leafy vegetables, such as cabbage and lettuce. Trim the excess fat from meat and remove the skin from poultry and fish because some pesticide residues collect in the fat.
- Eat a variety of foods from various sources, as this can reduce the risk of exposure to a single pesticide. You can also reduce your exposure to pesticides by choosing organic foods, as discussed shortly.

Growth Hormones and Antibiotics Are Used in Animals

Introduced in the U.S. food supply in 1994, recombinant bovine growth hormone (rBGH) is a genetically engineered growth hormone. It is used in beef herds to induce animals to grow more muscle tissue and less fat. It is also injected into a third of U.S. dairy cows to increase milk output. Although the FDA has allowed the use of rBGH in the United States, both Canada and the European Union have banned its use for two reasons: 1. The available evidence shows an increased risk for mastitis (inflamed udders), in dairy cows injected with rBGH. Farmers treat mastitis with antibiotics, promoting the development of strains of pathogenic bacteria that are resistant to antibiotics. 2. The milk of cows receiving rBGH has higher levels of a hormone called insulin-like growth factor (IGF-1). This hormone can pass into the bloodstream of humans who drink milk from cows that receive rBGH, and some studies have suggested that an elevated level of IGF-1 in humans may increase the risk for certain cancers. However, the evidence from these studies is inconclusive.

Antibiotics are also routinely given to animals raised for food. For example, they are added to the feed of swine to reduce the number of disease outbreaks in

overcrowded pork production facilities. Many researchers are concerned that cows, pigs, chickens, and other animals treated with antibiotics are becoming significant reservoirs for the development of virulent antibiotic-resistant strains of bacteria—so-called “superbugs.” Recent federal testing of supermarket meats found that 39% of chicken products, 55% of ground beef, 69% of pork, and 81% of ground turkey harbored significant amounts of superbug bacteria

You can reduce your exposure to growth hormones and antibiotics by choosing organic eggs, milk, yogurt, and cheeses and by eating free-range meat from animals raised without the use of these chemicals. You can also reduce your risk by eating vegetarian and vegan meals more often.

Nutrigenomics studies the interactions among genes, the environment, and nutrition. Until the late 20th century, scientists believed that the genes a person is born with determined his or her traits rigidly, but we now know that genetic expression is influenced—perhaps significantly—by chemicals present in the foods we most commonly eat and the substances in our environment to which our cells are commonly exposed. These include chemicals present in tobacco, drugs, alcohol, and environmental toxins. This helps explain why the appearance and health of identical twins—who have the same DNA—commonly change as the twins age. Specific nutrient– gene interactions, including how nutrients might influence cellular communication, use and storage of energy, and other processes, nutrigenomics may help people reduce their risk of developing diet-related diseases and possibly even treat existing conditions through diet alone