



print

## The hazards and benefits of eating dirt

In 2000, ten scientists gathered in Atlanta, Georgia, USA for two days to talk about how much dirt people eat.

Yes, people eat dirt — especially children. The Environmental Protection Agency of the United States estimates that more than 20% of normal children eat around a teaspoon of soil on several occasions, usually between one and three years of age. Older children with a developmental delay may continue to eat dirt, and are at greater risk for the medical problems that ingesting soil may cause.

The soil in your back yard or your local park could pose several kinds of hazard:

- chemical contamination, especially heavy metals
- harmful bacteria, mostly from sewage or manure
- parasites, especially roundworms from pet or wildlife feces

Is eating dirt so dangerous that we should always be watching our children for this behaviour? According to doctors who study infectious diseases and poisonings, we should instead watch for several hazards that contribute to the risk. And there are some reasons to think that eating the occasional pinch of good clean dirt benefits the immune system.

Eating dirt isn't always a medical issue. Pica, pronounced PIE-kah, is a disorder in which people persistently eat things that are not food, including ice, hair, ashes, laundry starch, or soil. Pica is from the Latin word for magpie, a bird said to pick up and eat anything. But a pinch of dirt isn't enough to qualify, according to categories developed in the Atlanta meeting by experts gathered by the U.S. Agency for Toxic Substances and Disease Registry:

- Normal soil consumption: up to about 500 mg a day of soil consumption is considered normal in children up to 3 years old. Two pennies weigh about 500 mg.
- Soil pica: children who persistently eat more than 1 g a day of soil may be suffering from soil pica.

Dr. Jeremy Friedman, the division head of Paediatric Medicine at The Hospital for Sick Children (SickKids) in Toronto, agrees that most children eat soil as a normal exploratory phase. "It's important to distinguish between normal kids from 9 months to 2 years of age who experiment with putting things in their mouths, and older children with pica who will hunt down some soil and consume it," he said.

### Why do humans eat dirt?

Most adults would not be embarrassed to sink their fingers into fertile soil.



But young children often use their senses of taste and smell to explore the world, so perhaps for them eating a mouthful of loam is merely curiosity. Children are also more likely to eat soiled food, to eat with dirty hands, and to put things in their mouths. All these behaviours are normal, but they do add up to a surprising amount of soil, more than a gram each day in some children.

### What is dirt made of?

#### Topsoil

The top 30 to 50 cm beneath our feet is what we think of as "dirty." It's full of organisms, from insects and fungi down through roundworms to the simplest forms of life including bacteria and viruses.

#### Mineral soil

The lower layer of soil is usually derived from the underlying rock. The subsoil may be clay, gravel, or sand. Although it is dirt, subsoil is not really "dirty" — there's not much to fear in terms of disease-causing organisms, unless they are in the groundwater. Subsoil can be a hazard if it contains heavy metals, which can occur naturally or result from pollution.

### Reasons not to eat dirt

There's not much argument that some people eat dirt as a part of a rare but real eating disorder. Eating dirt can lead to gastrointestinal problems such as constipation, abdominal pain, vomiting, loss of appetite, and diarrhea. Normal children will rarely eat enough soil to get into this kind of trouble. Children who seem drawn to dirt and consume it in larger amounts or greater frequency should see a doctor to be checked for a dietary deficiency or other problems.

### Soil contamination

There are many chemicals from industry or household use that have been found in soil. It pays to know your local history, in this case. You might think you'd know if your neighbourhood were a munitions dump, but homeowners in Spring Valley, a Washington DC neighbourhood near the American University, were surprised. In 1993, utility workers digging a trench discovered the first of many buried artillery shells. The US Army Corps of Engineers continues to work on the site today, ensuring that they have removed all the heavy-metal laden soil, as well as chemical weapons residues.

On the other hand, the vast majority of us in Canada and the US have perfectly healthy, safe soil in our yards and neighbourhoods. The most widespread and serious health concerns caused by contaminated soil are due to lead and arsenic.

Lead is a potent toxin that can damage the nervous systems of embryos, breastfed infants, and young children. Long-term exposure to arsenic increases the risk of cancers of the skin, lungs, bladder, kidneys, and liver.

You may want to prevent your child from eating dirt and have your soil tested if:

- Your home is beside or used to be a gas station.
- Your home is on land previously used by a firing range, foundry, or factories that made paint, pesticide, or batteries.

The most common way children are poisoned with lead is through eating old paint chips, dust, or soil contaminated with lead. Gnawing on walls or furniture painted with old lead-based paint has also been a problem. Outside soil is a big component of house dust, so experts recommend wet-mopping floors instead of sweeping or vacuuming if the neighbourhood's soil is suspect.

Testing shows that many children ingest more lead than is safe. In the United States, about one in 20 preschool children have levels of lead in their blood thought to cause subtle neurological harm. In Canada, levels are lower, probably because of differences in the paint industry. The U.S. actually banned lead from indoor paint in 1978, while a Canadian voluntary ban went into effect in 1991. However, manufacturers in Canada had greatly reduced lead use decades earlier.

### **Symptoms of heavy metal poisoning**

Even small amounts of lead delay mental development, lower intelligence, impair hearing, and even affect balance. This damage to the nervous system may be irreversible.

Children with chronically elevated blood lead concentrations are often pale and irritable. They may experience sleeplessness, constipation, loss of appetite, abdominal pain, and headache.

Symptoms caused by poisoning with other heavy metals are similar. When children have consumed arsenic from contaminated soil, they may have:

- upset stomach or vomiting
- stomach cramps
- diarrhea
- swelling of the face
- headaches

These are common symptoms, so most children with these problems are not suffering from heavy metal poisoning.

As the medical director of the Ontario Poison Centre and a clinical toxicologist at SickKids in Toronto, Dr. Margaret Thompson gets a lot of questions about the toxic chemicals children might consume. She often has to reassure parents concerned about Paris Green-treated wood, which contains both mercury and arsenic to prevent fungal growth. "Don't burn the wood," Dr. Thompson emphasizes. "Other than that, it's safe to play on wood structures in playgrounds, and it's safe to play in sand or soil underneath that wood." Health Canada says we should also avoid using treated wood as mulch or compost.

One final source of contamination where children play is fuel oil tanks. A homeowner nightmare goes like this: Your home used to have an oil tank in the back yard, and now it doesn't. You have a patch of grey soil where plants don't grow so well. Oil in soil is both a health risk and a fire hazard and should be removed by qualified contractors.

### **Bacteria**

Healthy soil is full of bacteria. So it's surprising that infection with bacteria doesn't seem to be a common problem for children who eat soil.

Unfortunately, there are exceptions. A child's death in Maine, USA, was traced to the harmful bacteria in calf manure that his mother added to the family garden. The bacteria contaminated fresh vegetables harvested from the garden and affected people because the produce was not washed thoroughly. This is the only bacterial outbreak that has been linked to garden vegetables fertilized with manure.

In soil, the main risk is probably from coliform bacteria, the same organisms that live happily and helpfully in every mammal's gut. The bacterium *Escherichia coli* is one of these intestinal companions. However, in water or soil it usually indicates that untreated sewage is present. Eating soil that contains coliform bacteria may sometimes cause a case of diarrhea. But the real danger is the aggressive strain called *E. coli* O157:H7.

*E. coli* O157:H7 is dangerous to humans. It causes a painful infection of the intestines, often with bloody diarrhea, thanks to a toxin produced by

the bacteria. Worse, 2% to 7% of those infected will develop hemolytic-uremic syndrome (HUS). The bacterial toxin, verocytotoxin, destroys red blood cells and attacks cells at the core of the kidney. The patient's kidneys may be damaged and shut down. In developed countries, HUS is the most common cause of acute kidney failure in children, and most cases of HUS are caused by *E. coli* O157:H7.

#### **Bacterial infection symptoms**

Diarrhea with blood is a serious symptom of an intestinal problem. You should seek treatment for your child if they have this symptom. Often, HUS does not occur until after the child has started to recover from the bout of diarrhea. HUS will cause your child to make less urine, and water will build up and swell the feet and hands. The child may be pale, irritable, and tired. While adults generally become ill and recover, HUS can be life-threatening to children and the elderly. It's also likely that damage to the kidneys and blood vessels will cause ongoing medical problems for some victims.

Toxin-spewing bacteria infesting soil is a hazard, but a very rare one. It's fairly clear that other soils, more typical of a suburban garden or a forest floor, are not likely harmful to eat in small amounts. Most harmful gut bacteria can't survive or reproduce in soil. *E. coli* O157:H7, for instance, dies rapidly in competition with soil's many less-dangerous inhabitants.

You do have cause for concern if:

- You use fresh manure or sewage sludge to fertilize your lawn, garden, or fields.
- You live on a farm that has free-ranging livestock. Most children on farms grow up healthy, but there have been cases of children acquiring *E. coli* infections and being hospitalized with HUS. You may want to create a safe play area for children away from livestock.

Many gardeners stay away from fresh manure, instead using composted manure. Proper composting makes manure safe with a high-heat phase and a long "curing" process during which the friendly micro-organisms overwhelm the harmful minority.

#### **Roundworm contamination**

##### **Eyes and brain at risk**

In 1998, an 11-month old boy from Pacific Grove, California, was carried into a local Emergency Department because he was irritable, groggy, and wasn't responding to his family normally. After some detective work, doctors realized he was fighting an invasion of tiny raccoon roundworms that had already done damage to the retina of one of his eyes, leaving a track of scars.

Although his infection was caught fairly early and treated aggressively, the boy's sight was permanently and seriously damaged, and he suffers from seizures and serious co-ordination problems caused by the damage done as roundworm larvae migrated through his brain.

Investigators found 21 raccoon latrine sites on the family's small property in the San Francisco Bay area.

##### **What is a roundworm?**

Roundworms, scientifically known as nematodes, are a large category of small, simple animals, most of which spend their lives crawling through soil or as parasites, hiding inside a host.

Roundworms of several species are sold to gardeners to improve their soil by attacking insect larvae. These roundworms are not parasitic and don't create a hazard in the soil or food grown in your garden.

##### **Nematodes in raccoon feces**

The raccoon roundworm, also known as *Baylisascaris procyonis*, lays eggs in the animal's gut. The eggs pass from the raccoon in the feces. The eggs can become mixed into the soil as the raccoon feces decay. "Children are at risk if they eat this soil, either on purpose or while consuming a snack in the sandbox," according to Dr. Jason Brophy, an Infectious Disease fellow at SickKids. The roundworm eggs will survive the child's stomach acid and hatch in the intestine.

Dr. Brophy urges calm though, because although perhaps half of raccoons in North America carry this infection, there have been less than 15 human cases in the medical literature, with only two deaths. Many children probably come into contact with the roundworm eggs, ingesting small doses, and do not suffer noticeable ill effects. Still, raccoon feces are a noxious addition to the soil and should be cleaned up, not left to melt into the ground.

#### **Dogs and cats have roundworms too**

A much more common roundworm infection in North America is *Toxocara* worms that live in dogs and cats. Even in modern cities, around 5% of people have antibodies in their blood, revealing they have fought this parasite. The best defence is to deworm pets regularly and clean up any pet feces where children might play.

Both *Toxocara* and *Baylisascaris* roundworm eggs can survive for years in friendly soil. The eggs can remain viable long after the animal's feces have decayed completely.

#### **Growing up too clean**

With concerns about chemical contamination, bacteria, and nematodes, it's clear that consuming dirt isn't without risk. Yet it does not seem that eating soil is all risk and no benefit. Soil consumption in children appears to be driven by a biological need. Scientists have many speculations about this need, but little real evidence.

The hygiene hypothesis suggests that early exposure to bacteria reduces allergies and improves a child's resistance to disease. According to this theory, children who grow up in environments that are very clean develop allergies and other immune disorders because their immune systems haven't had enough experience with friendly visitors or dangerous invaders. Researchers who study the immune system are divided on the hygiene hypothesis, and there is substantial evidence both for and against it.

The largest part of our immune system shadows our intestines. This gut-associated lymphoid tissue, or GALT, keeps our normal gut bacteria in line and helps recognize and fight off unwelcome newcomers. But animals raised in a sterile environment without contact with bacteria do not develop normal GALT.

Eating dirt might be one way that animals, including people, can get some "experience" with bacteria and learn to tell the harmless from the deadly. The bacterial count in dirt is large, but mostly harmless.

And there is more than just bacteria, fungi, and roundworms in that peck of dirt. Manufacturers add clay-like compounds to some vaccines to increase the immune system's response, making the inoculation more protective. It's possible that a child's mud pie may be a kind of primitive self-vaccination, letting the gut get used to a selection of common bacteria that rarely cause harm.

Most dirt is safe, despite the thousands of species of bacteria and other organisms it contains. Understanding the dangerous exceptions can make outdoor time safer for you and your children.

#### **Ensuring safe play**

Here are some pointers to reduce your child's exposure to soil dangers:

- Clean up animal feces in your yard, especially racoon poop. Wear disposable gloves, launder your clothes, and wash your hands very thoroughly afterwards.
- Watch children carefully when they're playing outside and make sure they understand that dog parks, ditches, and farmer's fields are the wrong places to dig in the dirt, and definitely the wrong places to eat some.
- Teach your child that it's important to wash thoroughly after playing in soil, sand, or mud. Remember to put this rule into practice yourself.
- Be vigilant if you use manure or sewage sludge to fertilize your lawn, garden, or fields. Consider switching to well-composted manure.
- Make sure your child's diet has plenty of calcium, iron, and zinc. This helps prevent dirt cravings and can also reduce the amount of lead absorbed from soil or paint that is eaten.
- If you live on a farm that has free-ranging livestock, make sure your children understand the hazards of fresh manure. You may want to consider a safe play space for your children, fenced off from your cattle.
- Know your house. Is that red or white paint from before 1991 when Canada banned lead in paints? Is the paint flaking, chipping, or deteriorating into dust? Are you sanding or stripping surfaces covered in old paint? Consider your options and seek professional advice. Trying to remove lead paint yourself is very dangerous to yourself and your children.
- Know the local history. Was your neighbourhood previously home to a paint, pesticide, or battery factory, a metal plating plant, a steel mill, a firing range, a gas station, or some other facility where lead, cadmium, or arsenic were used?

There is strong evidence that vaccination, drinking water purification, and sewage treatment have a huge payoff and a small price to human health. On the other hand, the hygiene hypothesis sends us a warning that it is unwise to avoid all exposure to the infectious world around us. No one should encourage their child to munch down on some garden soil. But if you've checked for the danger signs described above, your child is at a low risk from any dirt they do consume around your home.

#### Resources:

Ontario Poison Centre at <http://www.ontariopoisoncentre.ca> or 1-800-268-9017 24 hours a day.

Health Canada. Effects of lead on human health.  
[http://www.hc-sc.gc.ca/iyh-vsv/environ/lead-plomb\\_e.html](http://www.hc-sc.gc.ca/iyh-vsv/environ/lead-plomb_e.html)

Ontario Green Tips / Doing Your Part: Residential Fuel Oil.  
<http://www.ene.gov.on.ca/cons/3676e.htm>

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