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The Scoop on Eating Dirt

New findings suggest that ingesting soil is adaptive, not necessarily pathological

In the fall of 2009 a group of biology students at Tufts University sat down together and ate some dirt. They ground up small clay tablets and swallowed the powder to find out, firsthand, what clay tastes like. This unusual taste test was part of a Darwinian medicine class taught by one of us (Starks). The students were studying the evolution of geophagia—the practice of eating dirt, especially claylike soils, which is something animals and people have been doing for millennia.

The standard reference guide for psychiatrists—the fourth edition of the *Diagnostic and Statistical Manual for Mental Disorders (DSM-IV)*—classifies geophagia as a subtype of pica, an eating disorder in which people consume things that are not food, such as cigarette ash and paint chips. But as the students would learn, studies of animals and human cultures suggest that geophagia is not necessarily abnormal—in fact, it may well be adaptive. Researchers are taking another look at dirt eating and discovering that the behavior often provides people and animals with vital minerals and inactivates toxins from food and the environment.

EVOLUTIONARY APPROACH

ONE WAY TO DECIDE whether geophagia is abnormal or adaptive is to determine how common the behavior is in animals and across human societies. If many different species and cultures demonstrate the same behavior, then it is probably beneficial in some way.

Today it is clear that geophagia is even more widespread in the animal kingdom than previously thought. Investigators have observed geophagia in more than 200 species of animals, including parrots, deer, elephants, bats, rabbits, baboons, gorillas and chimpanzees. Geophagia is also well documented in humans, with records dating to at least the time of Greek physician Hippocrates (460 B.C.). The Mesopotamians and ancient Egyptians used clay medicinally: they plastered wounds with mud and ate dirt to treat various ailments, especially of the gut.



Some indigenous peoples in the Americas used dirt as a spice and prepared naturally bitter foods such as acorns and potatoes with a little clay to counteract the acerbic taste. Geophagia was a frequent practice in Europe until the 19th century, and some societies, such as the Tiv tribe of Nigeria, still rely on cravings for dirt as a sign of pregnancy.

A common explanation for why animals and people eat dirt is that soil contains minerals, such as calcium, sodium and iron, which support energy production and other vital biological processes. The fact that an animal's need for these minerals changes with the seasons, with age and with overall health may explain why geophagia is especially common when an animal's diet does not provide enough minerals or when the challenges of the environment demand extra energy. Mountain gorillas and African buffalo that live at high altitudes may, for example, ingest earth as a source of iron that promotes red blood cell development. Elephants, gorillas and bats eat sodium-rich clays when they do not get enough sodium in their diet. One elephant population is known to continually visit underground caves where the animals dig up and eat salt-enriched rock.

Among human populations in Africa, those who have ready access to calcium do not practice geophagia as often as those deprived of calcium. The need for calcium may also partly explain

why geophagia is most commonly associated with pregnancy: a mother needs extra calcium as the fetal skeleton develops.

Mineral acquisition does not fully explain geophagia, though. In an extensive review paper published in the 2011 *Quarterly Review of Biology*, Sera L. Young of Cornell University and her colleagues conclude that eating earth rarely adds significant amounts of minerals to one's diet and, in many cases, interferes with the absorption of digested food from the gut into the bloodstream, sometimes resulting in nutrient deficiency.

If animals and people are not getting much in the way of dietary minerals from dirt, what is the benefit of geophagia? A second explanation—that eating dirt is often a form of detoxification—is gaining credence.

DIRT DETOX

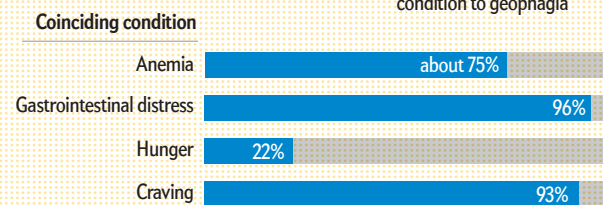
THE IDEA THAT, IN MOST CASES, eating dirt is probably a way to get rid of toxins could explain why people and animals so often prefer claylike soils to other kinds of earth. Negatively charged clay molecules easily bind to positively charged toxins in the stomach and gut—preventing those toxins from entering the bloodstream by ferrying them through the intestines and out of the body in feces. Detoxification might also explain why some indigenous peoples prepare meals of potatoes and acorns with clay—these foods are bitter because they contain small amounts of toxins.

In the 1990s James Gilardi, executive director of the World Parrot Trust, found support for the detoxification hypothesis in one of the few experimental studies on geophagia. While observing a flock of Peruvian parrots foraging on a particular band of exposed soil along the Manu River, Gilardi noticed that the birds neglected nearby stretches of soil with far more minerals. He surmised that the parrots were not ingesting soil for minerals but rather to counteract toxic alkaloids in the seeds and unripe fruit that make up a large part of their diet. Toxins prevalent in plants (and meats) often irritate the gut. To test this idea, Gilardi fed some parrots the toxic alkaloid quinidine with and without their preferred dirt and measured how much alkaloid made it into the birds' blood after the meal. Birds that did not consume the soil had higher levels of quinidine in their blood, whereas a side dish of dirt reduced quinidine levels in the blood by 60 percent. Researchers have shown the same benefit in chimpanzees and baboons that supplement their diets with clay.

Further evidence of dirt detox comes from studies of bats. A 2011 study in *PLoS ONE* asked whether Amazonian bats visit clay licks—cliff sides of exposed clay—for nutrition or detoxification. Christian Voigt of the Leibniz Institute for Zoo and Wildlife Research in Berlin and his colleagues captured bats of two different species: one that eats mostly fruit and one that eats mostly insects. If the bats were eating clay for minerals, Voigt predicted, he would find fewer fruit-eating bats at the clay licks because fruits have more dietary minerals than insects. But most of the bats he captured at the clay lick were fruit-eating bats—and many of them were pregnant or lactating. Voigt concluded that the pregnant fruit bats visited the clay licks to detox because they were eating twice as much to feed their babies, which meant twice the dose of plant toxins from unripe fruits, seeds and leaves.

Like bats, pregnant women may also eat dirt for its detoxifying properties, in addition to using dirt as a supplemental source

Why People Eat Dirt



NEW CLUES: In a review of 278 studies, gastrointestinal upset coincided with geophagia more often than anemia did, suggesting that dirt eaters primarily used soil to alleviate nausea and secondly as a mineral supplement. Likewise, far more dirt eaters are motivated by cravings than by hunger.

of minerals. The first trimester of pregnancy plagues many women with nausea and vomiting, and cross-cultural studies document geophagia early in pregnancies in response to morning sickness. Women in sub-Saharan nations and in the southern U.S. have reported that they consume clay to alleviate this discomfort. Some researchers have proposed that morning sickness purges the mother of toxins that might harm the fetus. Perhaps geophagia and morning sickness work together to protect the developing fetus. Because clay can bind bacteria and viruses, it may also protect both mother and fetus from food-borne pathogens such as *Escherichia coli* and *Vibrio cholerae*.

Although the scientific community has only recently accumulated enough evidence to argue that geophagia is an adaptive behavior, people—and not just pregnant women—have used clay minerals as remedies for nausea, vomiting and diarrhea for thousands of years. In the age of modern medicine, pharmaceutical companies harnessed the binding properties of kaolin, a clay mineral, to produce Kaopectate, a drug that treats diarrhea and other digestive issues. Eventually the synthetic chemical bismuth subsalicylate—also the key ingredient in Pepto-Bismol—replaced kaolin, but the clay is still used today in other ways. Kaolin and smectite bind not only harmful toxins but also pathogens. Ranchers use clay when preparing livestock feed to inhibit toxin transmission, and some researchers have proposed harnessing clay's pathogen-binding talents to purify water.

Of course, ingesting dirt can also be poisonous. Along with minerals and detoxifying materials, you might unintentionally ingest bacteria, viruses, parasitic worms, and dangerous amounts of lead or arsenic. Because of these risks, modern dirt eaters should stick with safe commercial products that have been heated or otherwise sterilized—but they should not be stigmatized for their behavior. Taken as a whole, the evidence argues that geophagia, in many cases, is not a sign of mental illness. It is a specific defense that has evolved to combat toxins and, possibly, ease mineral deficiencies. Although you may not be thinking about geophagia when you take vitamins or seek comfort from a swig of Kaopectate, you are in fact participating in the age-old practice of eating dirt. ■

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SOURCE: "WHY ON EARTH: EVALUATING HYPOTHESES ABOUT THE PHYSIOLOGICAL FUNCTIONS OF HUMAN GEOPHAGY," BY SERA L. YOUNG ET AL., IN *QUARTERLY REVIEW OF BIOLOGY*, VOL. 86, NO. 2, JUNE 2011