



Germ at Home

Article

PART 1

MANAUS, Brazil. Whether it's a jungle hut or a high-rise apartment, your home is covered in bacteria. Now, new research from the Amazon rainforest suggests that city dwellers might want to open a window.

Scientists traveled from remote villages in Peru to a large Brazilian city to begin tracking the effects of urbanization on the diversity of bacteria in people's homes. In other words, they wondered, "Do city homes have different types of bacteria than rural homes?" It's a small first step in a larger quest to understand how different environmental bacteria help shape what's called the microbiome, or the trillions of bacteria that share our bodies and play a critical role in our health.

Everyone carries a customized set of microbes on the skin, in the nose, and in the gut. This microbial zoo, which begins forming at a person's birth, aids in digestion and immune development. Some of these bacteria are beneficial for a person's health, while others are harmful. What influences the balance of good bacteria versus bad varies, depending on factors like a person's diet or any antibiotics he or she may take. Environmental exposure plays a role, too. The hygiene hypothesis, for example, suggests that immune-related conditions such as asthma and allergies are on the rise in some parts of the world because of a lack of early contact with once-common bacteria. This hypothesis seems to be bolstered by the fact that children who grow up on farms or around animals tend to have fewer of those immune-related ailments.

Increasingly, scientists studying the microbiome are investigating indoor spaces where people spend a lot of time, particularly homes. One of those scientists is microbiologist Maria Gloria Dominguez-Bello, who led the study in Peru and Brazil.

"Very little is known about the microbes of the built environment," said Dominguez-Bello.

To track the effects of urbanization, Dominguez-Bello's team analyzed the microbial communities of 10 houses and their inhabitants from each of three Peruvian locations—a village of hunter-gatherers; a slightly more modern rural village; and Iquitos, a medium-sized city not accessible by roads. The scientists also analyzed the bacteria in homes in the more populated Brazilian city of Manaus.

The housing styles were different in each setting. In the jungle, large families typically shared open-air huts with no external walls; in rural villages, homes had walls, but the room dividers didn't reach the roof; and in the city, homes were larger, with standard rooms and smaller families.

The team discovered that as people living in the Amazon rainforest become more urbanized, the kinds of bacteria in their homes change. While the more crowded jungle and rural homes in the study contained bacteria mostly found in nature, such as those commonly found in soil and water, the urban homes contained bacteria that typically live on



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Microbiologist Maria Gloria Dominguez-Bello, left, collects temperature data from the floor of a hut in Peru. She led a study in Peru and Brazil about bacteria in homes.

people.

And, the researchers discovered, the more urbanized a dwelling, the more human bacteria live on its walls and floors—even though urban dwellings have fewer human occupants. In fact, in city dwellings, the researchers could discern just by the microbial fingerprints on the walls whether the room was a kitchen, bathroom, or living room. In Manaus, a collection of microbes normally found in the mouth—including various species of strep bacteria—and in the gut were the most important in telling rooms apart.

"That's amazing," Dominguez-Bello said. "The walls talk."

The team reported that compared with less urban homes that are open to air circulation, walls in urban homes were acting as traps as people shed bacteria, a finding that so struck Dominguez-Bello that she insisted the windows in her New York office be unsealed so she could open them.

These results are similar to those from research done in U.S. homes and hospitals about the role of ventilation, said microbiologist Jack Gilbert of the Argonne National Laboratory and University of Chicago. Gilbert was not involved in Dominguez-Bello's study. But he has conducted a study of his own. Gilbert was able to match which family lived in different locations by the bacteria they shed inside their homes.

"Our modern homes are set up perfectly" for studying microbes, Gilbert said.

The Associated Press contributed to this story.

PART 2

Dig Deeper

Most single-celled organisms without a nucleus are classified as bacteria. Bacteria are found in almost every environment and perform a variety of tasks. Some bacteria contain chlorophyll. Using sunlight for energy, these bacteria are an important food source in oceans. These bacteria also release oxygen gas, which animals need to breathe.

Bacteria without chlorophyll perform different tasks. Some bacteria break down parts of dead plants and animals to help recycle matter. Some bacteria release chemicals into the environment, providing a food source for other organisms. Scientists often group bacteria by the roles they play in the environment.

- **Producers**

Bacteria that transform energy from sunlight into energy that can be used by cells are called producers. These bacteria are a food source for organisms that cannot make their own food.

- **Decomposers**

Decomposers get energy by breaking down materials in dead or decaying organisms. Decomposers help other organisms reuse materials found in decaying matter.

- **Parasites**

Some bacteria live in a very close relationship either inside or on the surface of other organisms. Some of these bacteria may have no effect on their host organisms or host cells. Some bacteria help their hosts. Other bacteria are parasites, organisms that harm their hosts.

Bacteria may help or harm other organisms. These are just a few examples:

Helpful Bacteria

- One shovelful of ordinary soil contains trillions of bacteria, and every fallen leaf or dead animal is covered with bacteria. These bacteria break down the matter in dead bodies and waste materials. These broken-down materials are then available for other organisms to build their bodies.
- Bacteria that live in your intestines help you break down food and provide you with vitamins, such as vitamin K.
- Cities use bacteria to break down sewage. Bacteria in sewage-treatment plants live on the material dissolved in liquid sewage. These bacteria help make the water clean enough to be released into rivers or oceans. Other bacteria can break down oil.
- Bacteria can change materials that do not come from living things and make them available for other organisms. For example, some bacteria can convert nitrogen gas to nitrogen compounds. This process, called *nitrogen fixation*, makes nitrogen available to plants in a form that is useful to them. Plants use this nitrogen in making proteins, which are an important part of every cell.

Harmful Bacteria

Scientists first discovered that bacteria cause some diseases in the late 1800s. Much of the scientific research into harmful bacteria developed because bacteria caused disease in humans. Tuberculosis, cholera, and strep throat are examples of disease caused by bacteria. Bacteria also may cause disease in many other animals and in plants. Bacteria can cause the symptoms of disease in three ways:

- They can invade parts of the body, multiplying in body tissues and dissolving cells.
- They can poison the body with chemicals they produce and release.
- They can poison the body with chemicals that are part of the bacteria themselves.

One way to fight bacterial disease is with vaccinations. Vaccines help individual organisms prepare to fight diseases they might encounter in the future. Humans, as well as cats and dogs, get vaccinations for bacterial diseases.

Dictionary

bolster (*verb*) to strengthen with support

decomposer (*noun*) an organism that feeds on and breaks down dead plant or animal matter

discern (*verb*) to identify or recognize as separate

parasite (*noun*) an organism that absorbs nutrients from the body of another organism, often harming it in the process

producer (*noun*) an organism that captures energy from sunlight and transforms it into chemical energy that is stored in energy-rich carbon compounds

Activity

PART 1

Question 1

Consider this quote from the Article:

"That's amazing. The walls talk."

In light of the main ideas of this Article, what caused microbiologist Maria Gloria Dominguez-Bello to make such a public statement?

- Ⓐ Researchers discovered that, even with few occupants, urbanized dwellings could be identified down to specific rooms based on the human bacteria that exist on the walls.
- Ⓑ A microbiologist at the Argonne National Laboratory found that families could be matched with their particular dwellings according to the specific bacteria each family shed inside the home.
- Ⓒ Scientists studied the hypothesis that children who grow up in rural settings are exposed to bacteria from a variety of animals, which may change their likelihood of developing allergies.
- Ⓓ A team of researchers reported that the human body's functioning is greatly altered by a microbial zoo, which begins forming at birth on the skin, in the nose, and in the gut.

Question 2

The best alternate headline for this Article would be _____.

- Ⓐ The Microscopic Residents in Your Home May Surprise You
- Ⓑ New York Windows Finally Unsealed and Opened
- Ⓒ Exposure to Some Types of Bacteria May Help Children
- Ⓓ Exterior Walls of a Home May Affect Your Health

Question 3

Which is the closest **synonym** for the word *discern*?

- Ⓐ Replicate
- Ⓑ Distinguish
- Ⓒ Tolerate
- Ⓓ Undermine

Question 4

Which of these is a statement of opinion?

- (A) Scientists found that urban homes with fewer residents contained a greater amount of human microbes than more crowded homes in rural settings.
- (B) Strep bacteria normally found in the mouth assisted researchers in determining from which room in a home microbe samples were taken in a study.
- (C) Regularly inspecting the ventilation system is the most important preventive maintenance task for a facility supervisor within a hospital setting.
- (D) Jungle huts in the Amazon rainforest that are open to the outdoors were found to contain bacteria typically found in water and soil.

Question 5

The reader can infer from the Article that _____.

- (A) A fund will be created so that rural homes in Peru can be sanitized and then have floor-to-ceiling walls and sealed windows installed.
- (B) Officials in Brazil will demand that urbanization be halted due to recently discovered levels of microbial communities in the environment.
- (C) Research like the study done by microbiologist Maria Gloria Dominguez-Bello in Peru and Brazil may one day influence the way homes are designed and built.
- (D) Microbes from urban dwellings in Peru and Brazil may be collected and introduced into rural dwellings in order to better balance the bacteria throughout the Amazon rainforest.

Question 6

Which two words are the closest **synonyms**, as they're used in the Article?

- (A) Urbanized and customized
- (B) Microbe and ailment
- (C) Accessible and remote
- (D) Investigate and analyze

Question 7

Suppose Deion wants to find out about microbiomes. He would find **most** of his information _____.

- (A) In a natural science textbook in a section titled "Bacteria and the Human Body"
- (B) At a government meeting regarding the economic effects of urbanization in Manaus, Brazil
- (C) In a published research paper that examines the family dynamics in Iquitos, Peru
- (D) At a multigenerational family meeting of hunter-gatherers who reside in Peru

Question 8

Which statement from the Article best supports the idea that urban dwellings pose different health risks than rural homes?

- Ⓐ The team discovered that as people living in the Amazon rainforest become more urbanized, the kinds of bacteria in their homes change.
- Ⓑ What influences the balance of good bacteria versus bad varies, depending on factors like a person's diet or any antibiotics he or she may take.
- Ⓒ The scientists also analyzed the bacteria in homes in the more populated Brazilian city of Manaus.
- Ⓓ These results are similar to those from research done in U.S. homes and hospitals about the role of ventilation, said microbiologist Jack Gilbert of the Argonne National Laboratory and University of Chicago.