AMERICAN MUSEUM OF NATURAL HISTORY

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THE SECRET WORLD INSIDE YOU OPENS AT THE AMERICAN MUSEUM OF NATURAL HISTORY

NEW EXHIBITION EXPLORES THE TRILLIONS OF MICROSCOPIC ORGANISMS THAT LIVE ON US AND IN US

FROM NOVEMBER 7, 2015, TO AUGUST 14, 2016

The microbes in and on your body are more numerous than the stars in the Milky Way. Clump them together, and they weigh about as much as your brain—about three pounds. And contrary to the common misconception that all microbes—the term used for organisms that are too small to be seen with the naked eye—are "germs" that cause disease, most of the ones that live in your body are vital to keeping your digestive system, your immune system, and even your brain working properly. Opening on November 7, 2015, ***The Secret World Inside You***, a special exhibition from the American Museum of Natural History, uses larger-than-life models, computer interactives, videos, art installations, and a live theater to explore the rapidly evolving science that is revolutionizing how we view human health and understand the inner workings of our bodies.

"So much of the thrilling experience of visiting the Museum is about traveling through the natural world, out into to the universe, and among the cultures of humanity, yet some of today's most fascinating scientific frontiers are in realms invisible to the human eye, such as the human microbiome," said Ellen V. Futter, President of the American Museum of Natural History. "This exhibition introduces the public to an exciting and promising cutting-edge field, highlights the Museum's research related to human health, and shows how increasing intersections among the fields of comparative biology, genomics, ecology, and medicine are deepening our understanding of how humans evolved, fit in, and interact with the natural environment. It will change the public's understanding of ourselves—our bodies and our health—revealing that each of us is our very own ecosystem."

(more)

Our bodies are home to many trillions of microbes living in and on us, including bacteria, viruses, fungi, and other organisms collectively called the **human microbiome**. In any individual, microbial genes outnumber the genes in human DNA by more than 100 to one. Your body also contains more microbial cells than human cells—a new perspective that is changing and complicating our view of ourselves.

"Each of us is a complex ecosystem made of hundreds of species, one of which is human and the rest microbial," said Robert DeSalle, co-curator of *The Secret World Inside You* and a curator in the Museum's Division of Invertebrate Zoology and the Sackler Institute for Comparative Genomics. "This realization requires a paradigm shift in our view of the microbial world."

Investigating the human microbiome is a very young science, and researchers are just beginning to understand what constitutes a "normal" microbiome, how it changes over time, and how it affects health and disease. But what is clear is that the effects of the microbiome on its human host are profound and multifaceted—and could play an important role in common health problems like allergies, asthma, obesity, and even anxiety and depression.

DeSalle and exhibition co-curator Susan Perkins, also a curator in the Museum's Division of Invertebrate Zoology and the Sackler Institute for Comparative Genomics, are part of a core research group at the Museum focused on microorganisms, ranging from bacteria to parasites to algae [***See release on microbial research***].

"We've long known that we are hosts to bacteria on and within our bodies, but, historically, microbiologists have focused on studying individual species one at a time," Perkins said. "The increasing availability of advanced research technology like DNA sequencing has given us a different perspective: we see these microbes as part of larger communities that have evolved intimate relationships with us over many millions of years."

How do your interactions with microbes—from the type of environment where you grew up to the number of times you have taken antibiotics, which destroy both bad and good bacteria—influence your health? In what ways can your microbiome be said to be its own organ? And is it possible that the state of the bacteria in your gut plays a role in your mental health? ***The Secret World Inside You*** dives into these intriguing and other profound questions through an interactive tour of the human body, making stops at places where microbes thrive.

SKIN

Your skin covers about 20 square feet, making it the largest organ in your body, and microscopic organisms cover it from head to toe. From the point of view of a microbe, your skin is like an enormous continent, with resources that vary dramatically from one region to another. Differences in skin temperature, texture, thickness, humidity, and chemistry help determine which kinds of microbes live where.

The blend of bacteria on your skin also depends on who you are and how you live. For example, women's hands often have more lactic acid bacteria—similar to those used to make yogurt, pickles, and wine—than men, whose hands tend to have more Corynebacterium cells, related to the bacteria that are used to make the flavor ingredient monosodium glutamate, or MSG. But even on just one person, left and right hands likely have a different microbial mix, because conditions are different on each hand: One hand may be saltier, oilier or sweatier than the other. And your right hand and left hand may typically touch different things, picking up different microbes along the way.

New research continues to explore the factors that affect your personal mix of microbes. People living under the same roof have more bacteria in common than average, as family members likely transfer microbes by touching the same surfaces, as well as each other. And bacteria are thought to travel from the tongue and paws of dogs to the skin of their human companions. ***The Secret World Inside You*** explores the prevalence of bacteria in and on our bodies, including in our bellybuttons, in a live theater presentation.

DIGESTIVE SYSTEM

Millions of microbes enter your body at every meal. After your skin, the digestive system is the main place where your body comes in contact with microbes. But unlike your skin, your digestive system is a warm, sheltered space—and it's filled with food, making it the perfect spot for microbes.

The story starts with your mouth, where food—along with microbes—enters your digestive system. You probably have 100 to 200 microbial species living in your mouth right now. Most either do you no harm or actively protect you from infection. But if ecological conditions favor them, other microbes can cause tooth decay, bad breath, and gum disease.

Your digestive tract, or gut, is home to about 99 percent of your mirobiome. Very few bacteria can survive in the acidic environment of your stomach, but they thrive in the small intestine and large intestine, where most digestion and fermentation of food takes place,

respectively. The microbes here help with digestion, immune regulation, disease prevention, healing and protecting your gut lining, appetite control, brain development, and even emotion. In ***The Secret World Inside You***, a 6-foot tall **Winogradsky column**—a self-contained microbial ecosystem created using mud and nutrients like eggshells and newspaper scraps—illustrates how the bacteria in your digestive system separate based on habitat preference.

The exhibition also will highlight how varying diets affect the microbiome. For example, while red meat is an important source of nutrition in many cultures, it has also been shown to feed bacteria that can cause heart disease. Fiber-rich foods like beans, vegetables, fruits, and whole grains sustain beneficial bacteria in your large intestine. And live bacteria in cultured foods like yogurt stimulate your immune system and help keep out bacteria that cause disease. An **interactive game** in ***The Secret World Inside You*** will challenge visitors to keep a virtual microbiome healthy in three scenarios: meal time, with menu options ranging from broccoli to cookies to pickles; eliminating strep throat with a variety of antibiotics at your disposal; and deciding whether to prescribe a fecal transplant to battle antibiotic resistance. Visitors can also explore the factors that affect a healthy gut microbiome with an original card game called **Gutsy**, available for purchase in the exhibition's gift shop and online or as a free printable version [***See release on Gutsy***].

New studies are showing that microbes, along with diet and exercise, might be a factor in body weight, perhaps linked to antibiotic exposure. But recent research takes that one step further, suggesting that appetite, mood, mental illness—even bizarrely specific behaviors like the way we dress—may all be manipulated by microbes. This is because of something called the "gut-brain axis"— constant, two-way communication between your brain and your gut, which contains about 500 million neurons, via the vagus nerve and blood vessels that carry chemical messages such as hormones. More than 500 studies have linked the microbiome in mice and humans to behavior, anxiety, and depression.

REPRODUCTION

You inherited your human DNA from your parents—but your microbiome is more complicated. You might think that since your mother's body was teeming with trillions of bacteria, you'd be covered with them long before you were born. But exposure to bacteria before birth could be deadly for a fetus. So for nine months it grows in a nearly sterile "safe zone."

Shortly before birth, new bacteria appear in the mother's birth canal—species that normally live in her digestive tract. During birth, these bacteria get pressed into the baby's skin,

eyes, and mouth, and the baby swallows them. Babies born by Cesarean section don't get covered by helpful bacteria from the birth canal. Instead, they are covered by skin bacteria from the doctor's hands or whatever else is in the room. The long-term effects of Cesarean birth are not known, but there may be a slightly higher risk of allergies, asthma, gut infections and even diabetes.

Babies pick up a second dose of bacteria while breastfeeding. Mammalian breast milk contains the nutrients a baby needs—and the bacteria needed to jump-start the baby's immune system and digestive system, help prevent infection, and even affect brain development. New work also has shown that about 10 percent of breast milk consists of complex carbohydrates that cannot be digested by infants but are readily consumed by the dominant species of bacteria in the infant microbiome—evidence that we coevolved to live with these organisms.

Your microbiome is not only different from anyone else's, it's different at various stages of your life. The biggest shifts occur when you have a major change in diet. But adolescence, pregnancy, and old age can also alter your microbiome. ***The Secret World Inside You*** features a 14-foot projection of a pregnant woman's body as part of an **interactive table** that highlights the ways that microbes impact human health. Visitors can zoom in on 17 animated microbial scenes, from the mites that live harmlessly on your eyelashes, to the *Streptococcus* bacteria that cause plaque on your teeth, to the bacteria that break down the crystals that cause kidney stones.

EXHIBITION ORGANIZATION

The Secret World Inside You at the American Museum of Natural History is co-curated by Susan Perkins and Rob DeSalle, curators in the Museum's Division of Invertebrate Zoology and the Sackler Institute for Comparative Genomics. The exhibition will be open to the public from November 7, 2015, to August 14, 2016.

The exhibition is designed and produced by the American Museum of Natural History's award-winning Exhibition Department under the direction of David Harvey, senior vice president for exhibition

Generous support for ***The Secret World Inside You*** and its educational resources has been provided by the Paul and Irma Milstein Foundation and the Milstein Family.

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AMERICAN MUSEUM OF NATURAL HISTORY (AMNH.ORG)

The American Museum of Natural History, founded in 1869, is one of the world's preeminent scientific, educational, and cultural institutions. The Museum encompasses 45 permanent exhibition halls, including the halls of the Rose Center for Earth and Space and the Hayden Planetarium, as well as galleries for temporary exhibitions. It is home to the Theodore Roosevelt Memorial, New York State's official memorial to its 33rd governor and the nation's 26th president, and a tribute to Roosevelt's enduring legacy of conservation. The Museum's five active research divisions and three cross-disciplinary research centers support approximately 200 scientists, whose work draws on a world-class permanent collection of more than 33 million specimens and artifacts, as well as specialized collections for frozen tissue and genomic and astrophysical data, and one of the largest natural history libraries in the world. Through its Richard Gilder Graduate School, it is the only American museum authorized to grant the Ph.D. degree and, beginning in 2015, the Master of Arts in Teaching (MAT) degree. Both the Ph.D. and the MAT are the only such non-university, museum-based graduate programs in the United States. Annual attendance has grown to approximately 5 million, and the Museum's exhibitions and Space Shows can be seen in venues on five continents. The Museum's website and collection of apps for mobile devices extend its collections, exhibitions, and educational programs to millions more beyond its walls. Visit amnh.org for more information.

Hours

The Museum is open daily, 10 am–5:45 pm. The Museum is closed on Thanksgiving and Christmas.

Admission

Museum admission is free to all New York City school and camp groups.

Suggested general admission, which supports the Museum's scientific and educational endeavors and offers access to the Museum's 45 halls including the Rose Center for Earth and Space, is $22 (adults) suggested, $17 (students/seniors) suggested, $12.50 (children) suggested. All prices are subject to change.

The Museum offers discounted combination ticket prices that include suggested general admission plus special exhibitions, IMAX or 3D films, and Space Shows.

- Museum Plus One includes one special exhibition, IMAX or 3D film, or Space Show: $27 (adults), $22 (students/seniors), $16 (children)

- Museum Supersaver includes all special exhibitions, IMAX or 3D film, and Space Show: $35 (adults), $28 (students/seniors), $22 (children)

Visitors who wish to pay less than the suggested Museum admission and also purchase a ticket to attend a special exhibition, IMAX or 3D film, or Space Show may do so on-site at the Museum. To the amount they wish to pay for general admission, they add $25 (adults), $20.50 (students/seniors), or $13.50 (children) for a Space Show, special exhibition, or IMAX or 3D film.

Public Information

For additional information, the public may call 212-769-5100 or visit the Museum's website at amnh.org.

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