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Microbes are us: Diseases and nutrition.



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E N G I N E E R I N G A T I L L I N O I S



Microbes are everywhere (Mic)

Microorganisms

Are Everywhere!

On ocean floors, volcanoes, soil, plants, animals, body, skin, teeth, tongue, human gut (**30-400** trillion cells), humans (**15 trillion to 724** trillion cells)

<http://www.erfejmnihemobi/Microorganism/microorganisms-are-everywhere>

Sender R, Fuchs S, Milo R. Revised Estimates for the Number of Human and Bacteria Cells in the Body. PLoS Biol. 2016 Aug 19;14(8):e1002533.



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In living things, Microbes are hosts to multi-cell animals, plants.



And in humans...



Microbes have bacteria and archaea as one-cell, and have Eukaryotic hosts (nucleated fungi, multi-cell)

Phylogenetic Tree of Life

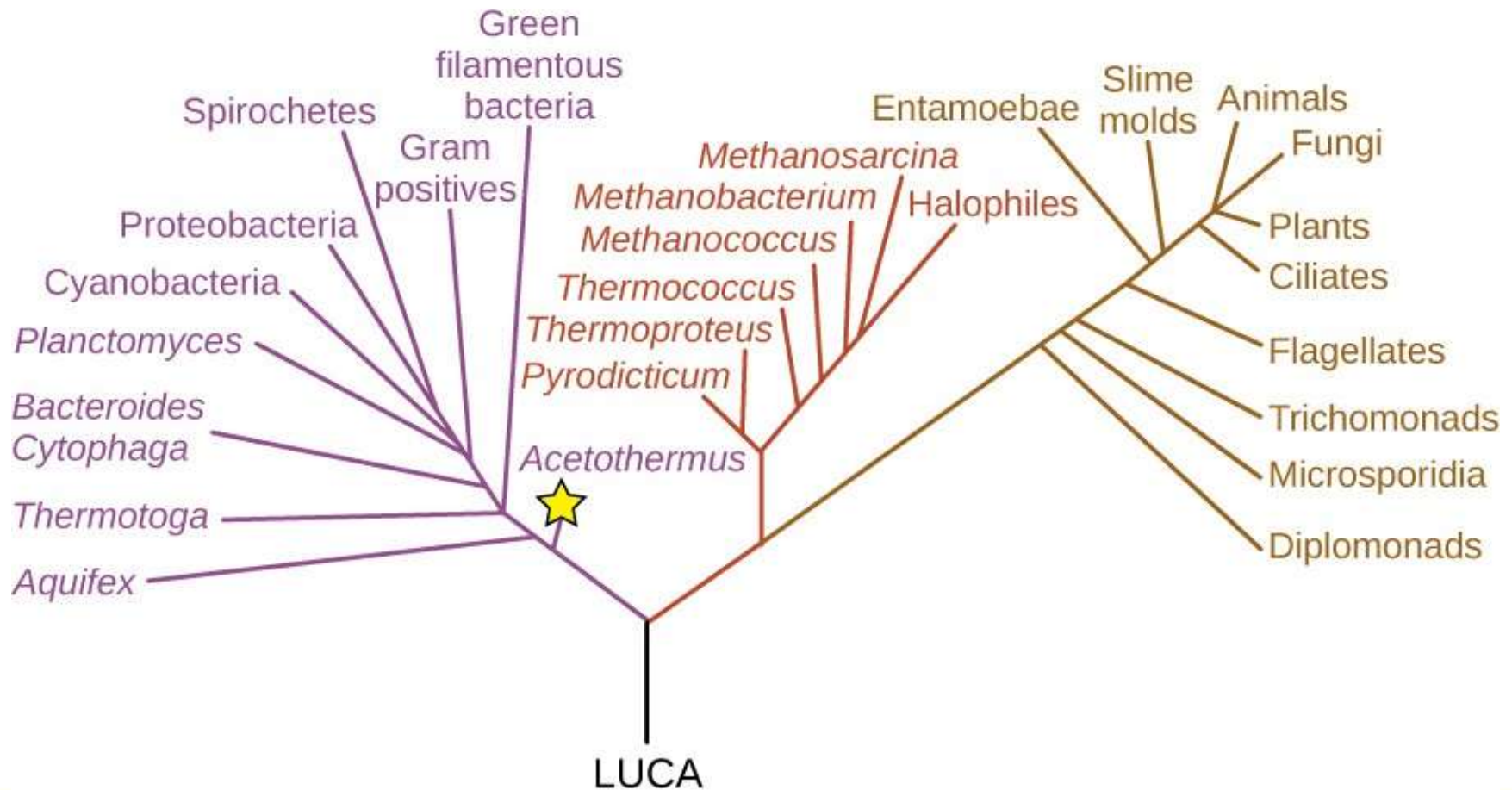
One-cell non-nucleated

Hosts: Animal and us, plants, etc

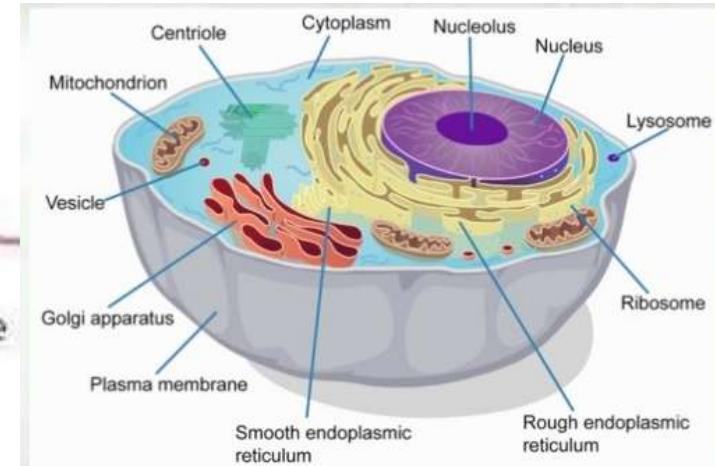
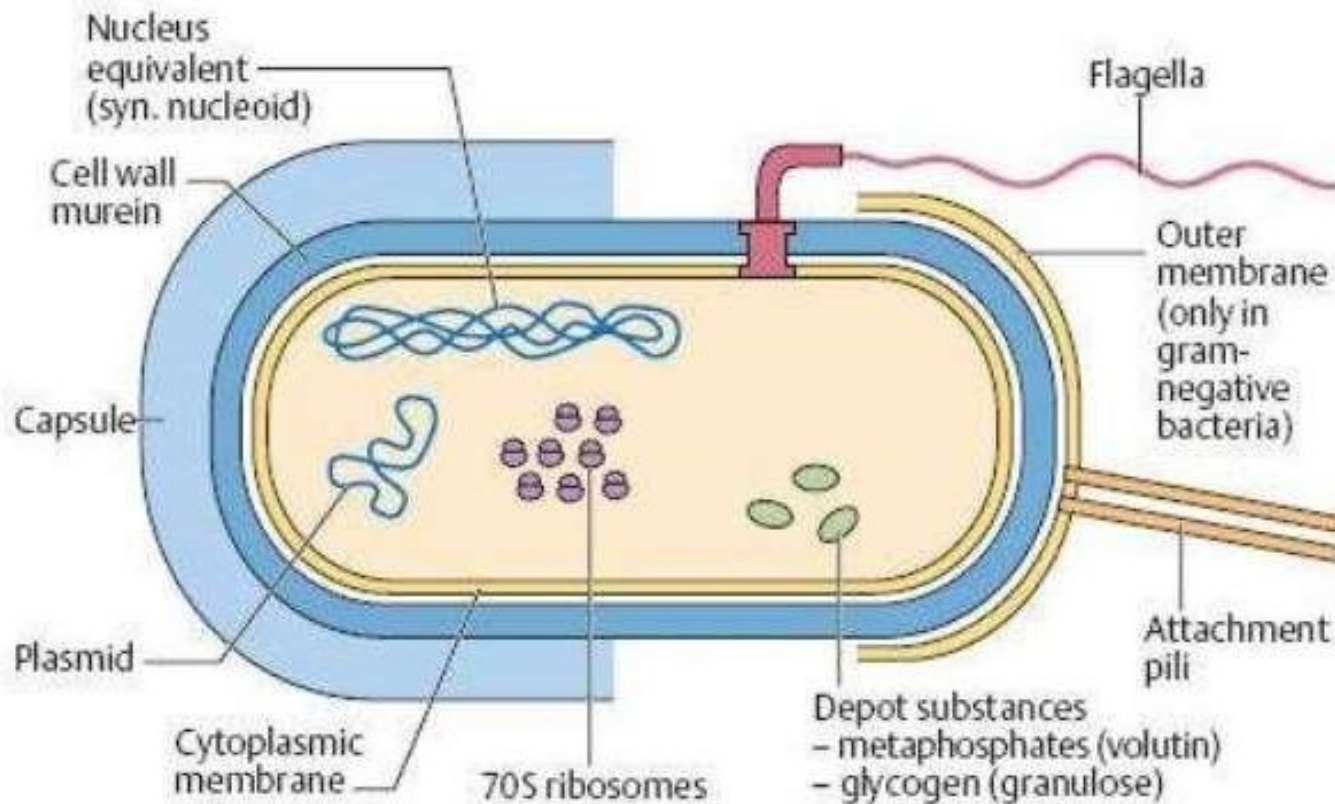
Bacteria

Archaea

Eukarya



Structure of non-nucleated bacteria and archaea








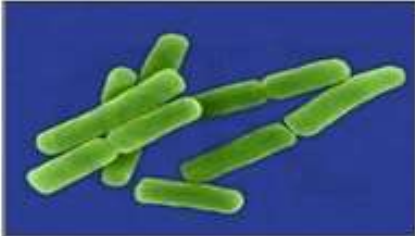
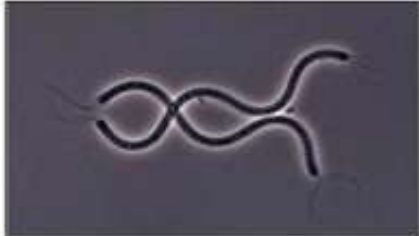
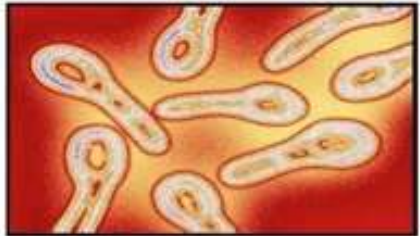
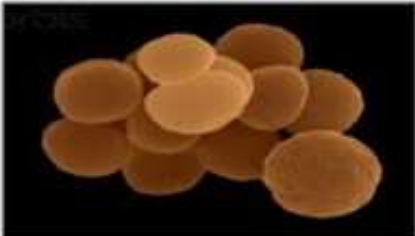


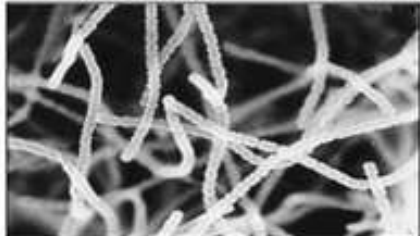
Vs Nucleated Eukaryotic

Bacteria and Archaea

One cell with cytoplasm, chromosome in nucleoid, and membrane(s).
Contains cell structures such as ribosomes, chromosome, and plasmid(s).
Gel-like matrix with water, enzymes, nutrients, wastes, and gases.

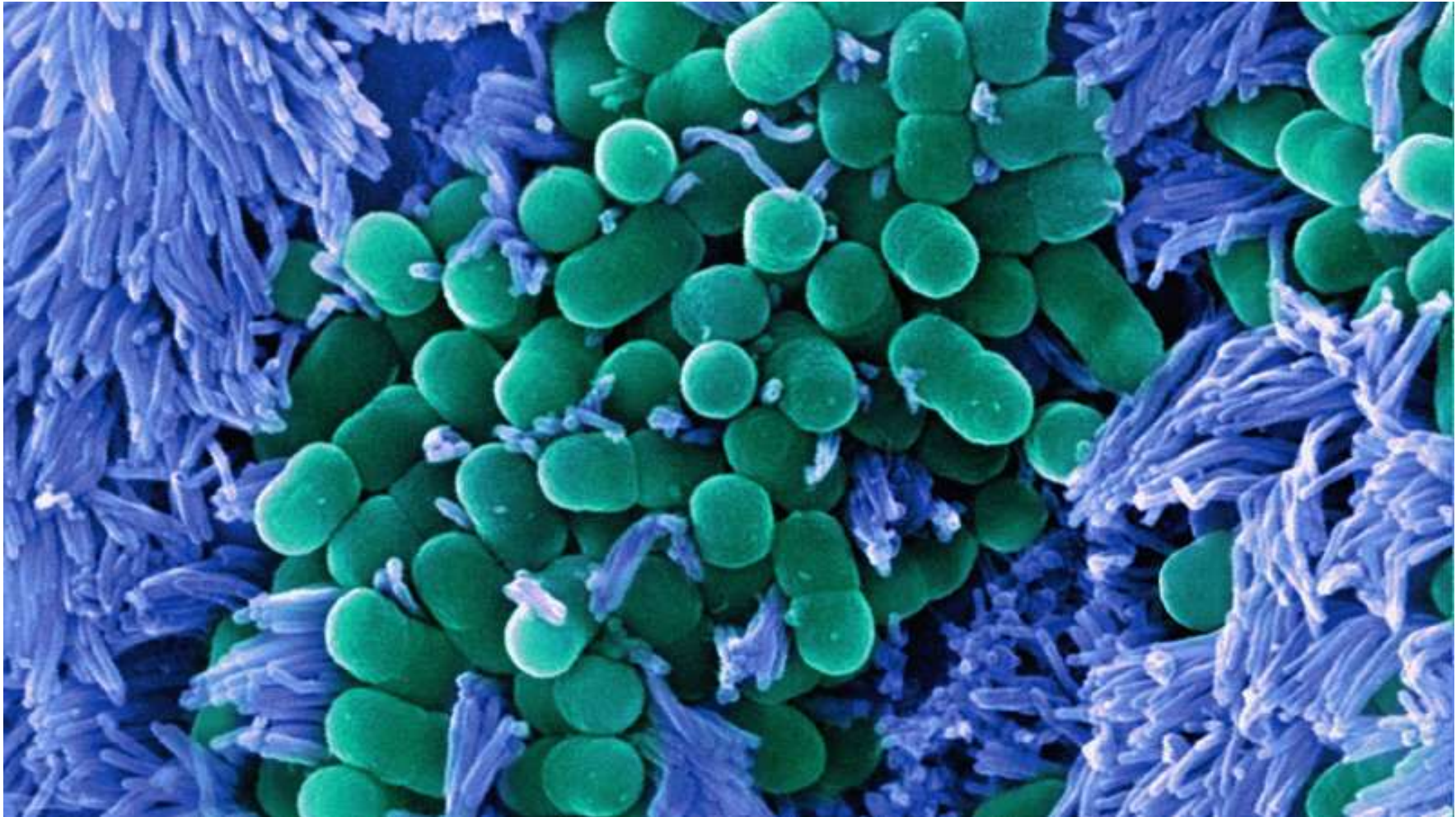


Shapes of non-nucleated bacteria and archaea

| Circular (Coccus) | Rod-shaped (Bacillus) | Curved Forms | Other Shapes |
|--|---|--|---|
|  <p>Diplo- (in pairs)</p> |  <p>Coccobacilli (oval)</p> |  <p>Vibrio (curved rod)</p> |  <p>Helicobacter (helical)</p> |
|  <p>Strepto- (in chains)</p> |  <p>Streptobacilli</p> |  <p>Spirilla (coil)</p> |  <p>Corynebacterium (club)</p> |
|  <p>Staphylo- (in clusters)</p> |  <p>Mycobacteria</p> |  <p>Spirochete (spiral)</p> |  <p>Streptomyces (filaments)</p> |



Microbes from a child's small intestine (green, E. Coli)



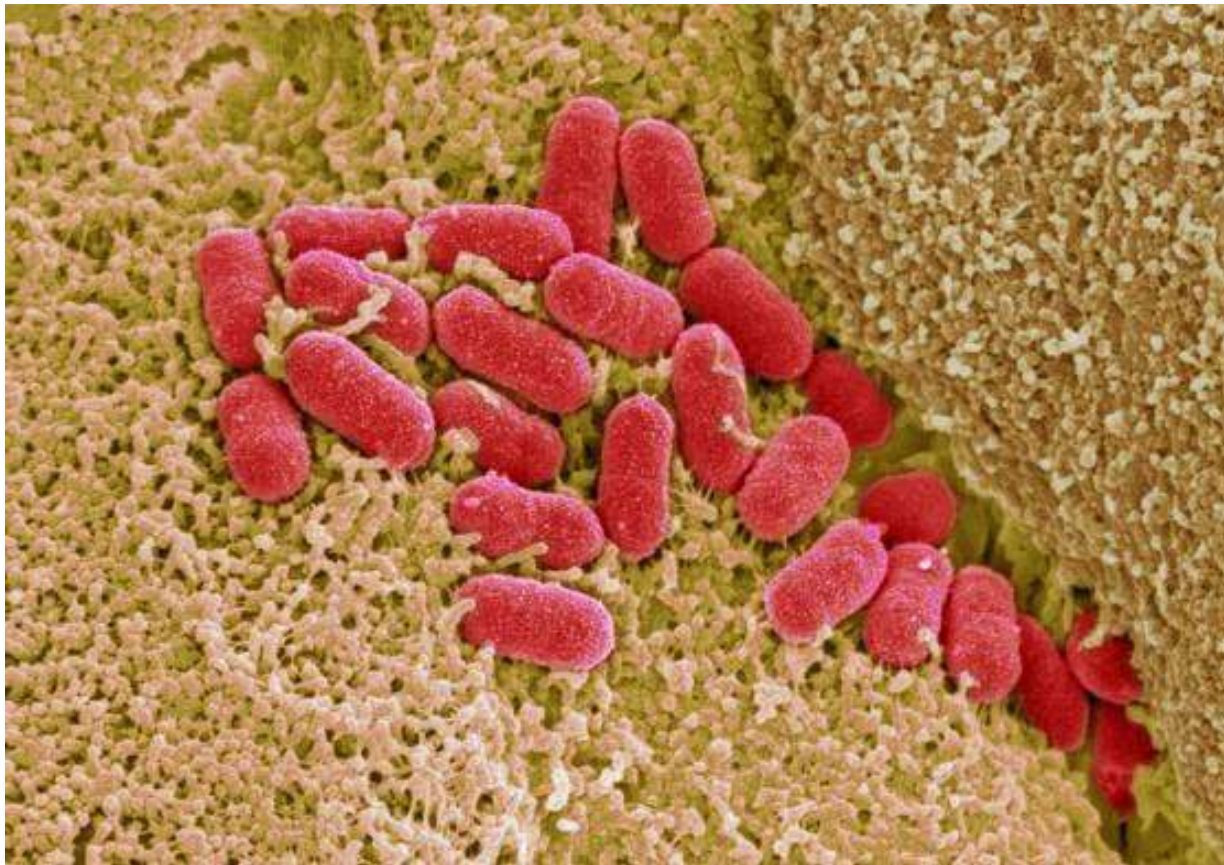
Colored scanning electron micrograph (SEM) of Escherichia coli bacteria (green) taken from the small intestine of a child. E. coli are rod-shaped bacteria that are part of the normal flora of the human gut. Microbes are the super-healers. Ed Yong. *I Contain Multitudes: The Microbes within Us and a Grander View of Life* Audio CD. [Stephanie Schuller/Science Source](#)



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Host vertebrates like Humans engulf pathogenic microbes as bacterial

Enterohemorrhagic *Escherichia coli*



SEM image showing EHEC binding to human colonic biopsy epithelium. Image by Steven Lewis, PhD Student in Stephanie Schuller's Group.

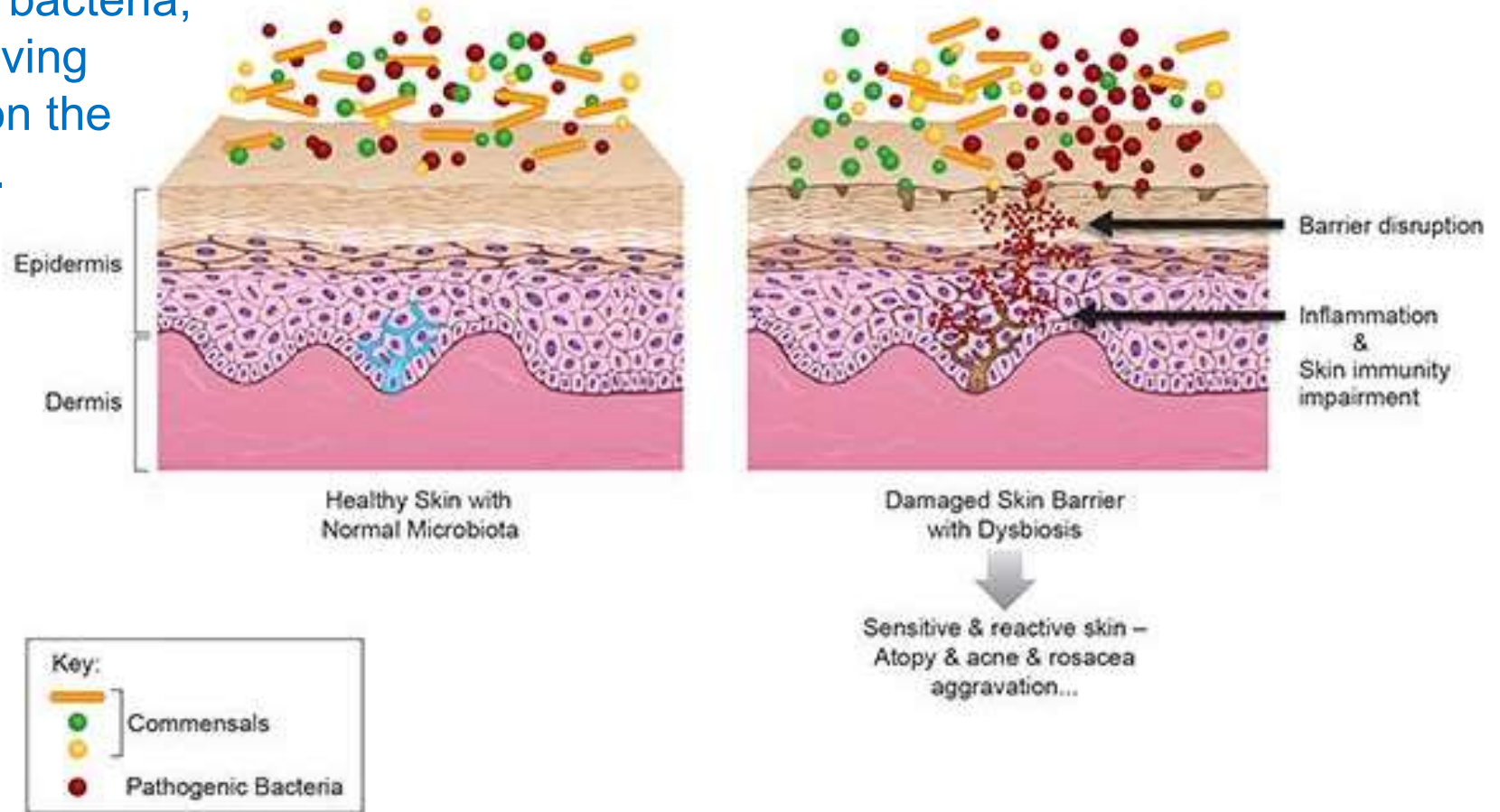
Lewis S.B., Cook V., Tighe R., Schüller S. Enterohemorrhagic Escherichia coli colonization of human colonic epithelium in vitro and ex vivo. *Infection and Immunity* doi: 10.1128/IAI.02928-14



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Microbes are the greatest barrier on the surface of skin

Microbes have bacteria, archaea, non-living viruses, fungi on the surface of skin.

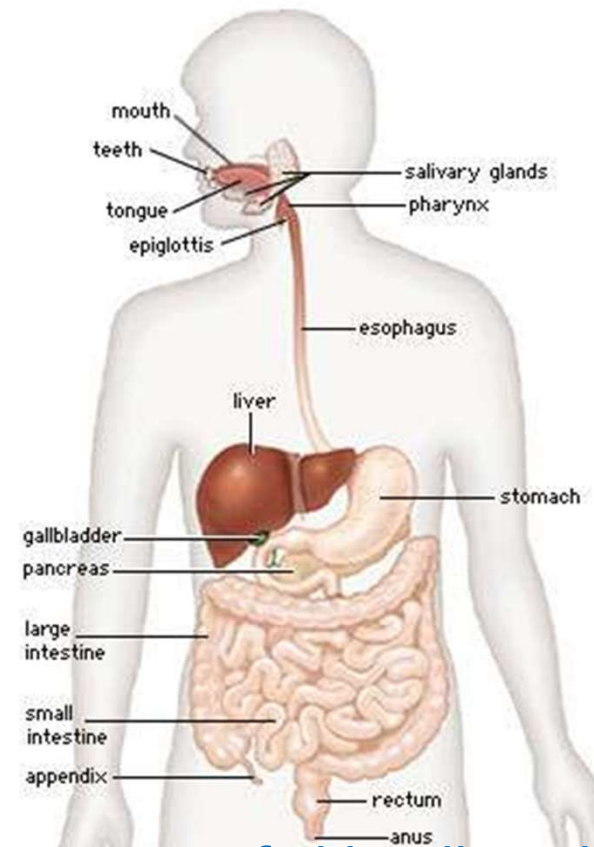


Source: *Journal of Drugs in Dermatology*



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Microbes are our defense, nutrient recycler and help prevent loss of water



Maintain structure of skin, digestive system.
through immune system via white blood cells.

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<https://www.britannica.com/science/alimentary-canal>

<https://whyfiles.org/2015/eight-ways-microbes-keep-you-healthy/index.html>

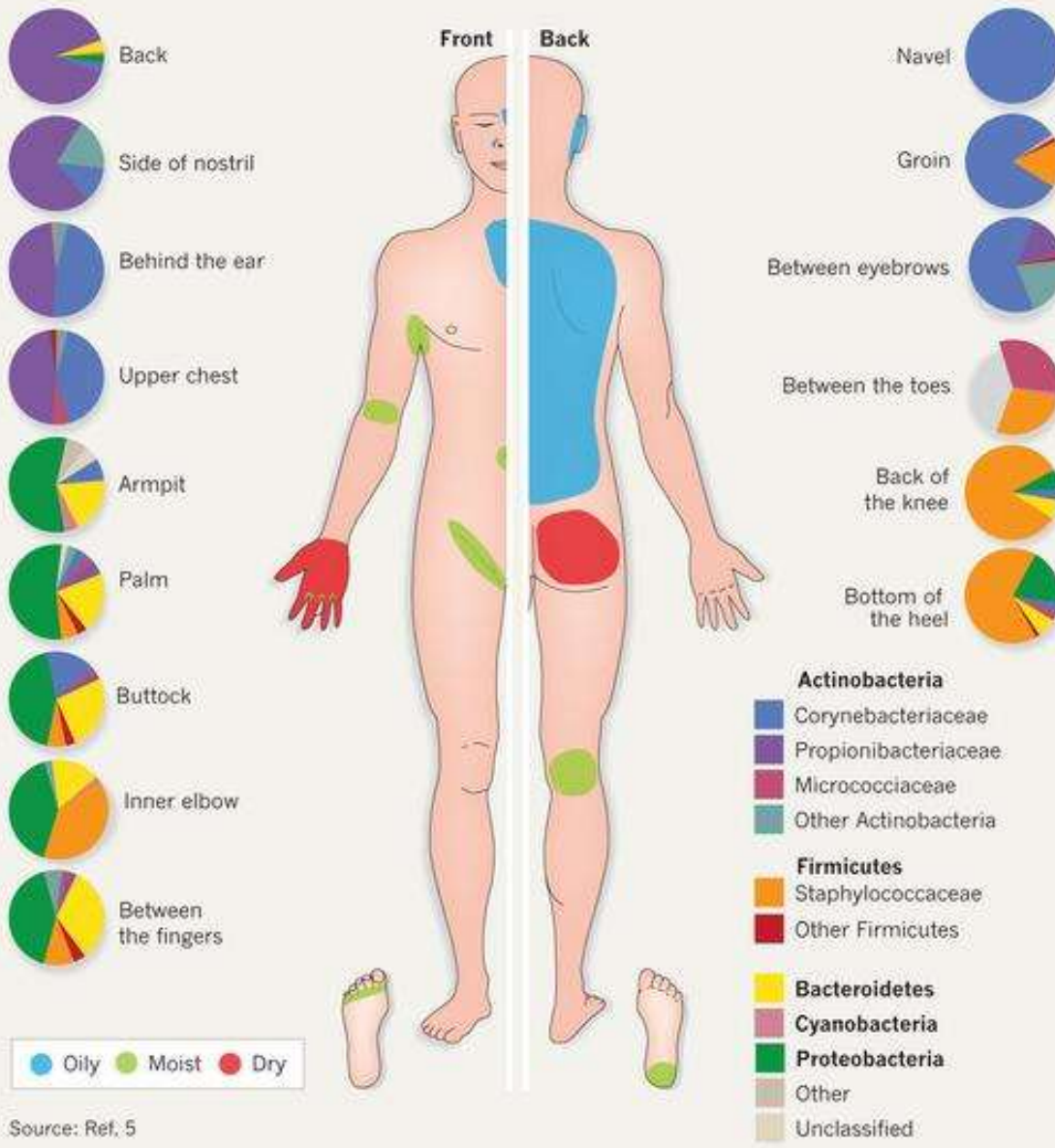


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MICROBIOME MAP

The human skin is rich with bacteria. The population and ratios vary by region, and depend on the whether the skin site is oily, moist or dry.



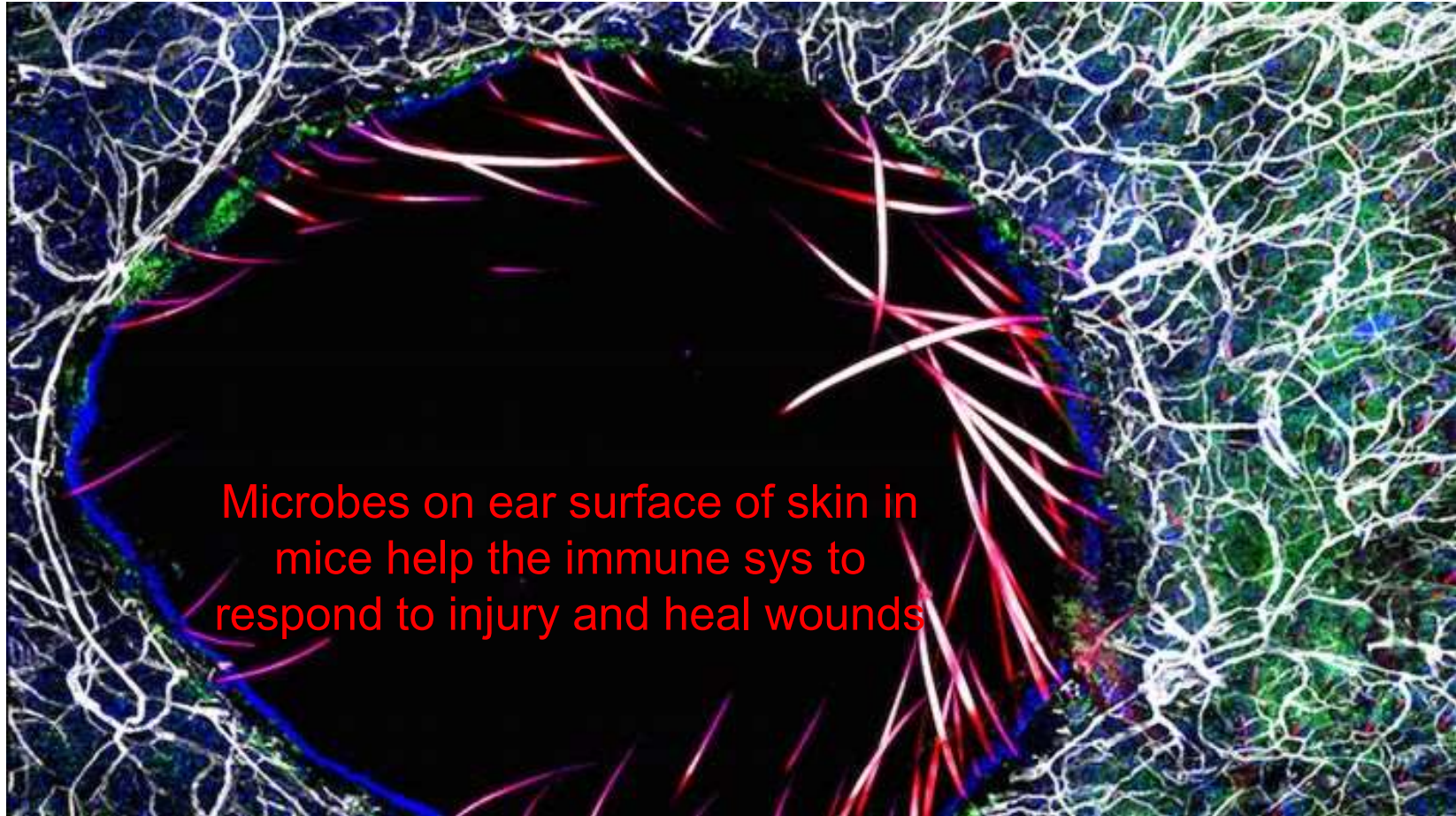
Microbiome map in human skin surface.

The NIH HMP Working Group, etc. *Genome Res.* 2009 Dec; 19(12): 2317–2323



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What happens when there is a cut on the skin?

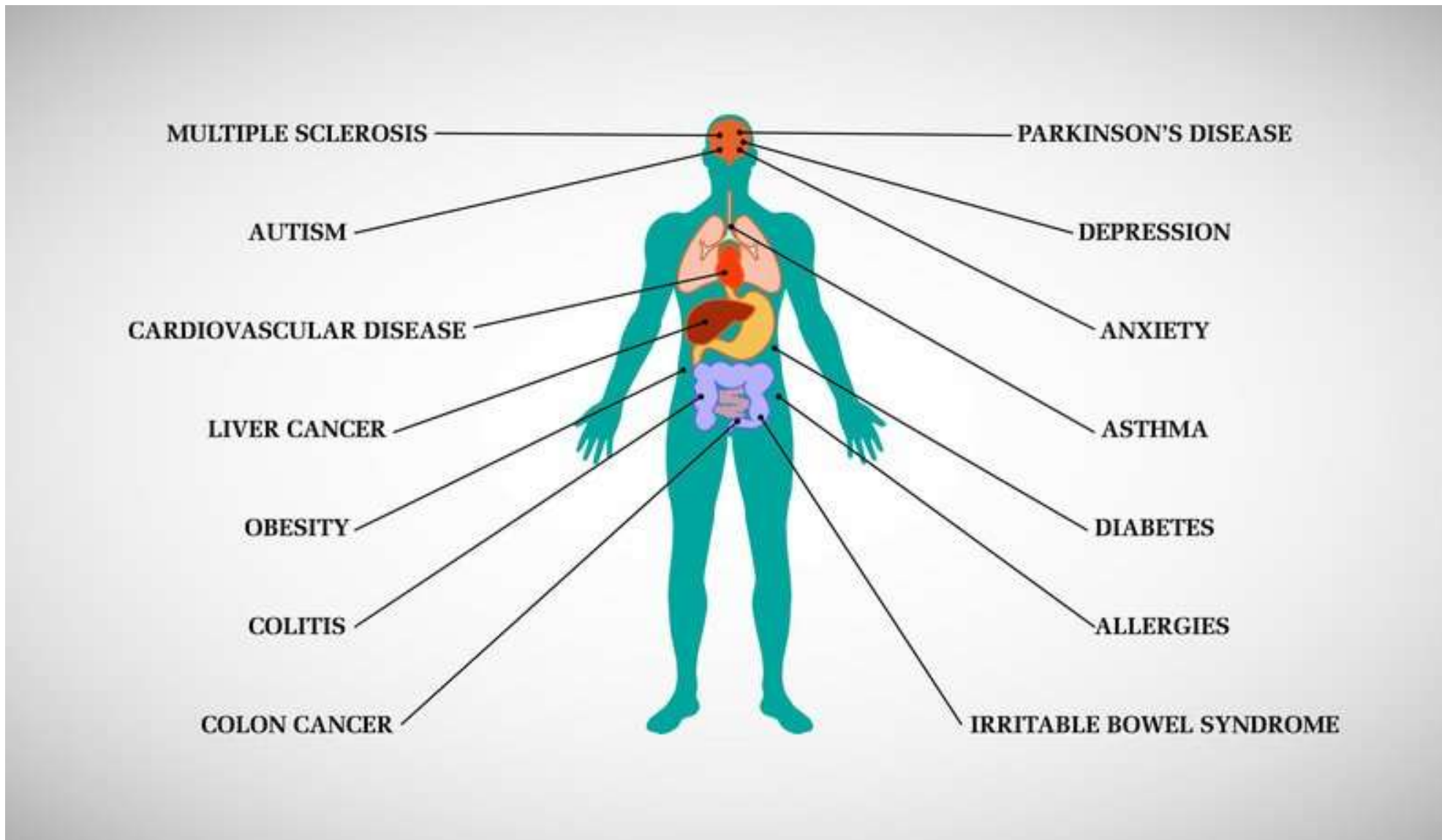


Microbes on ear surface of skin in mice help the immune sys to respond to injury and heal wounds

A whole-mount ear pinnae at 3 days after 2.5-mm ear punch biopsy from mice (15 days post-initial *S. epidermidis* association). Skin wound has hairs (pink-white), and surrounded by immune cells (green), and beneficial bacteria too small to view. C: NIAID Linehan JL, etc. Non-classical Immunity Controls Microbiota Impact on Skin Immunity and Tissue Repair. *Cell*. 2018 Feb 8;172(4):784-796.e18.



Many Diseases in Humans are due to pathogens

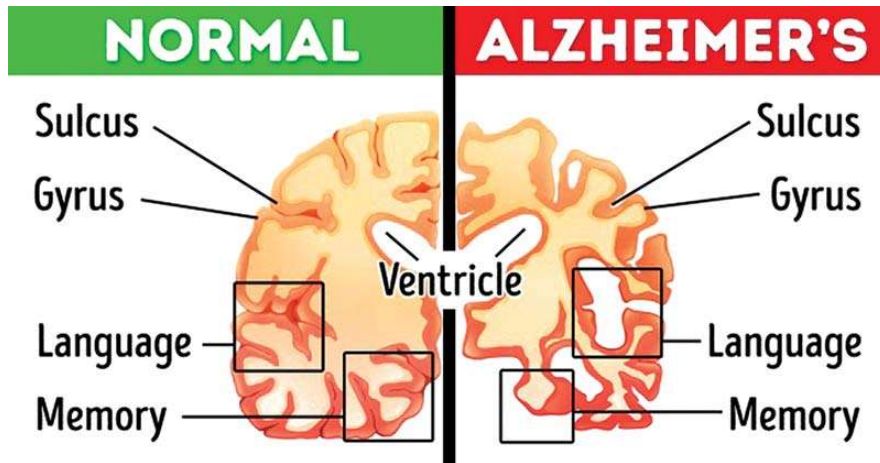


[The Microbiome: A Forgotten Organ | The Harvard Undergraduate.](#) Bryan Peacker '18, Jan 12, 2016



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Gum Disease Bacteria in Alzheimer's Disease in Brains.



Genetics



Memory loss and Language problems in Alzheimer → pathogens like viruses → gum decay through periodontitis.

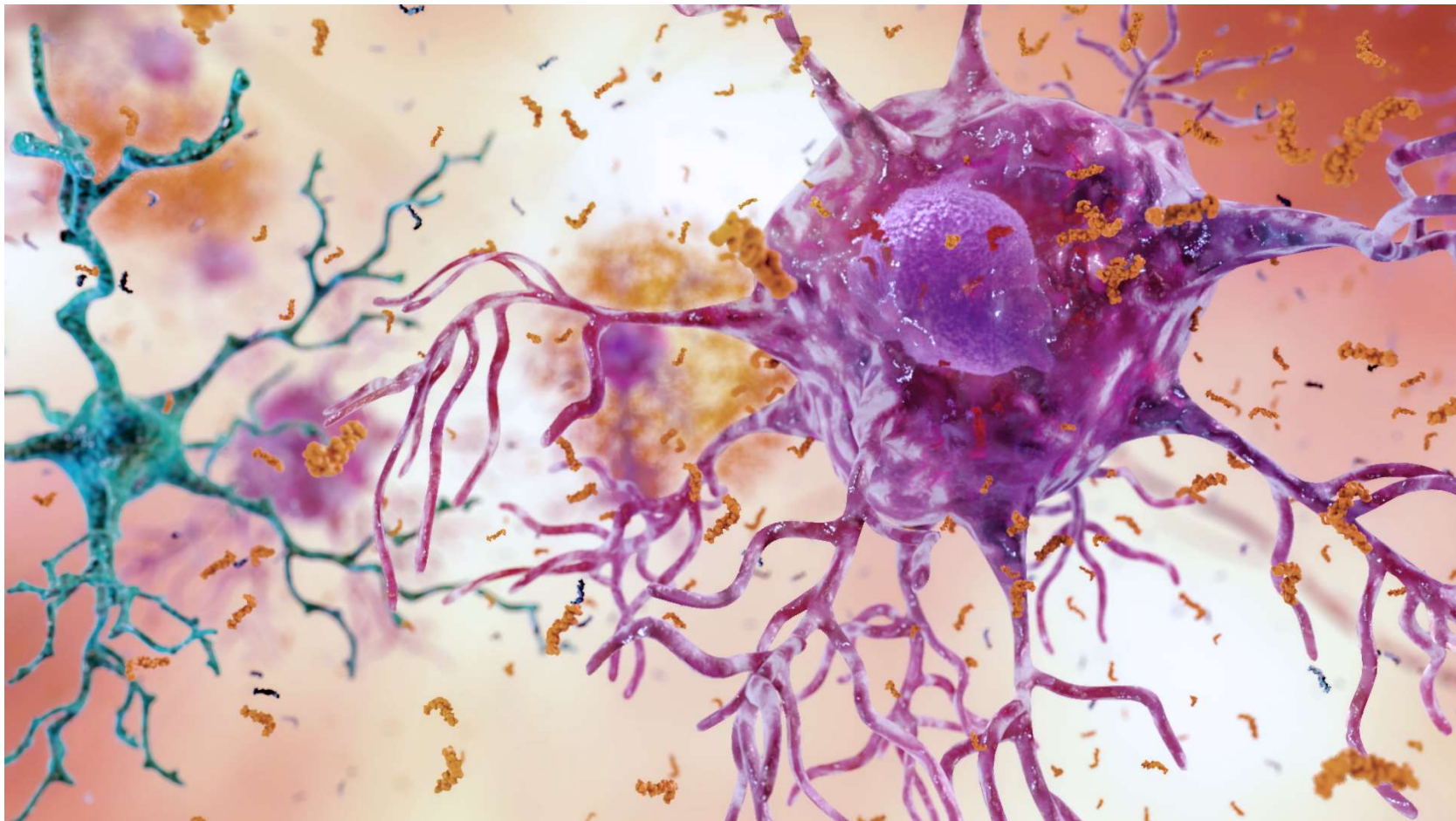
Tooth decay due to Chronic periodontitis (CP) and infection with *Porphyromonas gingivalis* (*P. gin*) may be leading cause.

Dominy SS, etc. Science Advances. 2019 Jan, 5(1), eaau3333.



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P. gin from teeth through blood may cause Alzheimer's in brain with plaques. A toxic protein secretes *gingipain* with protein *amyloid beta* to destroy neurons.



<https://www.nia.nih.gov/health/alzheimers-and-dementia/alzheimers-disease-fact-sheet>



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Conclusions



Microbes are in Humans, Animals, plants, soil, volcanoes to oceans.

In Humans as hosts, Microbes help protect us through Immunity against pathogens. White blood cells are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders.

Diseases like Obesity, Diabetes, Alzheimer's, colon cancer may be due to genetics, and due to stress, poor diet, and exercise.

We will give you nutritious recipes for preventing or fighting diseases.

Thank you!



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- ❑ <https://www.nia.nih.gov/health/alzheimers-and-dementia/alzheimers-disease-fact-sheet>



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