Surprises from Our Invisible Partners

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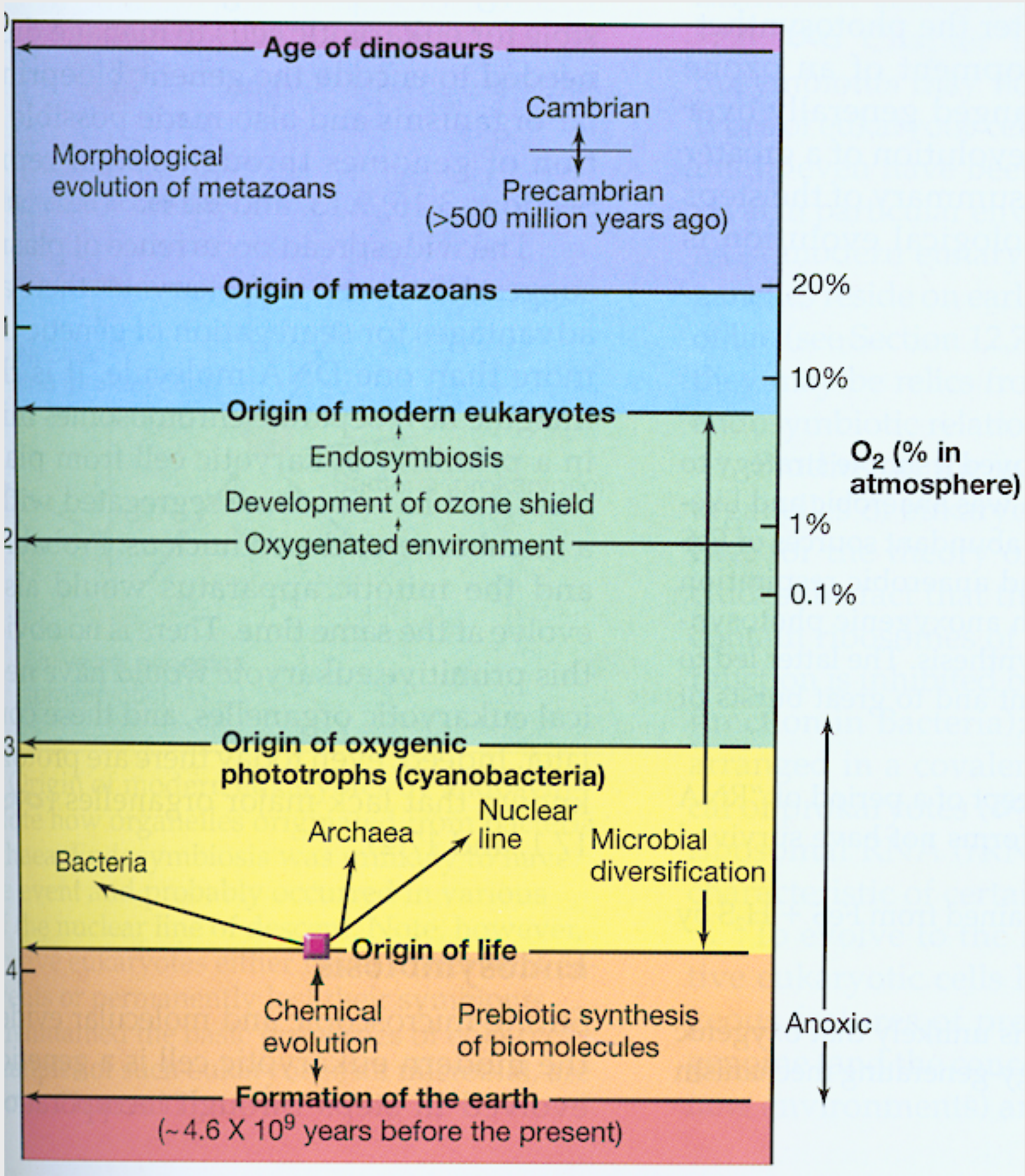
Microbes: Our Invisible but Invincible Partners

4.5 Billion
Years Ago

2.3 Billion
Years Ago

Today

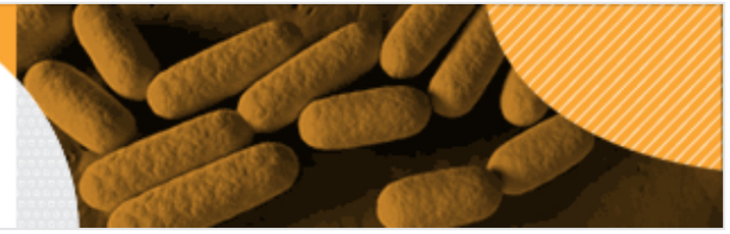
Billions years ago



Microbes have altered atmospheric gases since almost 4 billion years ago

Candradimuka crater,
Dieng plateau
Source :
Microbial gene pool from
extreme environments

INTERNATIONAL JOURNAL OF SYSTEMATIC AND EVOLUTIONARY MICROBIOLOGY
Official publication of the ICSP and the BAM Division of the IUMS



Sulfurisphaera javensis sp. nov., a hyperthermophilic and acidophilic archaeon isolated from Indonesian hot spring, and reclassification of *Sulfolobus tokodaii* Suzuki *et al*. 2002 as *Sulfurisphaera tokodaii* comb. nov.

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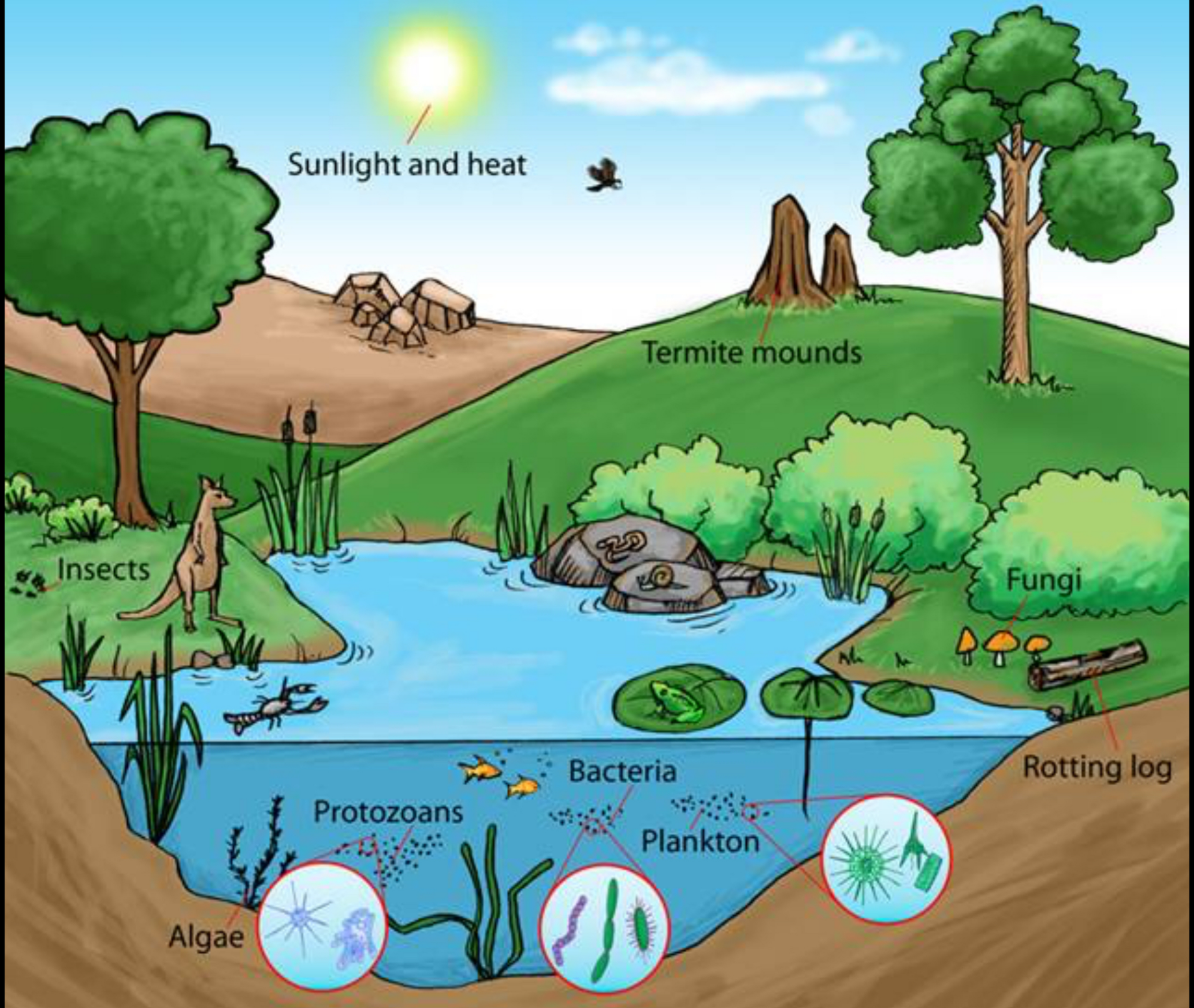
Abstract | Fulltext | Figs (2) | References (26) | Cited By (9) | Supplementary Material (1) | Metrics | Related Content

A novel hyperthermophilic, acidophilic and facultatively anaerobic archaeon, strain KD-1^T, was isolated from an acidic hot spring in Indonesia and characterized with the phylogenetically related species *Sulfurisphaera ohwakuensis* Kurosawa *et al*. 1998, *Sulfolobus tokodaii* Suzuki *et al*., 2002 and *Sulfolobus yangmingensis* Jan *et al*. 1999. Cells of KD-1^T were irregular cocci with diameters of 0.9–1.3 µm. The strain grew at 60–90 °C (optimum 80–85 °C), pH 2.5–6.0 (optimum pH 3.5–4.0) and 0–1.0% (w/v) NaCl concentration. KD-1^T grew anaerobically in the presence of S^0 (headspace: H_2/CO_2) and $FeCl_3$ (headspace: N_2). Under aerobic conditions, chemolithoautotrophic growth occurred on S^0, pyrite, $K_2S_4O_6$, $Na_2S_2O_3$ and H_2. This strain utilized various complex substrates, such as yeast extract, but did not grow on sugars and amino acids as the sole carbon source. The main core lipids were calditoglycerocaldarchaeol and caldarchaeol. The DNA G+C content was 30.6 mol%. Analyses of phylogenetic trees based on 16S rRNA and 23S rRNA genes indicated that KD-1^T formed an independent lineage near *Sulfurisphaera ohwakuensis* TA-1^T, *Sulfolobus tokodaii* 7^T and *Sulfolobus yangmingensis* YM1^T. On the basis of the results of morphological, physiological, chemotaxonomic and phylogenetic analyses, KD-1^T represents a novel species of the genus *Sulfurisphaera* Kurosawa *et al*. 1998, for which the name *Sulfurisphaera javensis* sp. nov. is proposed. The type strain is KD-1^T (=JCM 32117^T=InaCC Ar81^T). Based on the data, we also propose the reclassification of *Sulfolobus tokodaii* Suzuki *et al*., 2002 as *Sulfurisphaera tokodaii* comb. nov. (type strain 7^T=JCM 10545^T=DSM 16993^T).

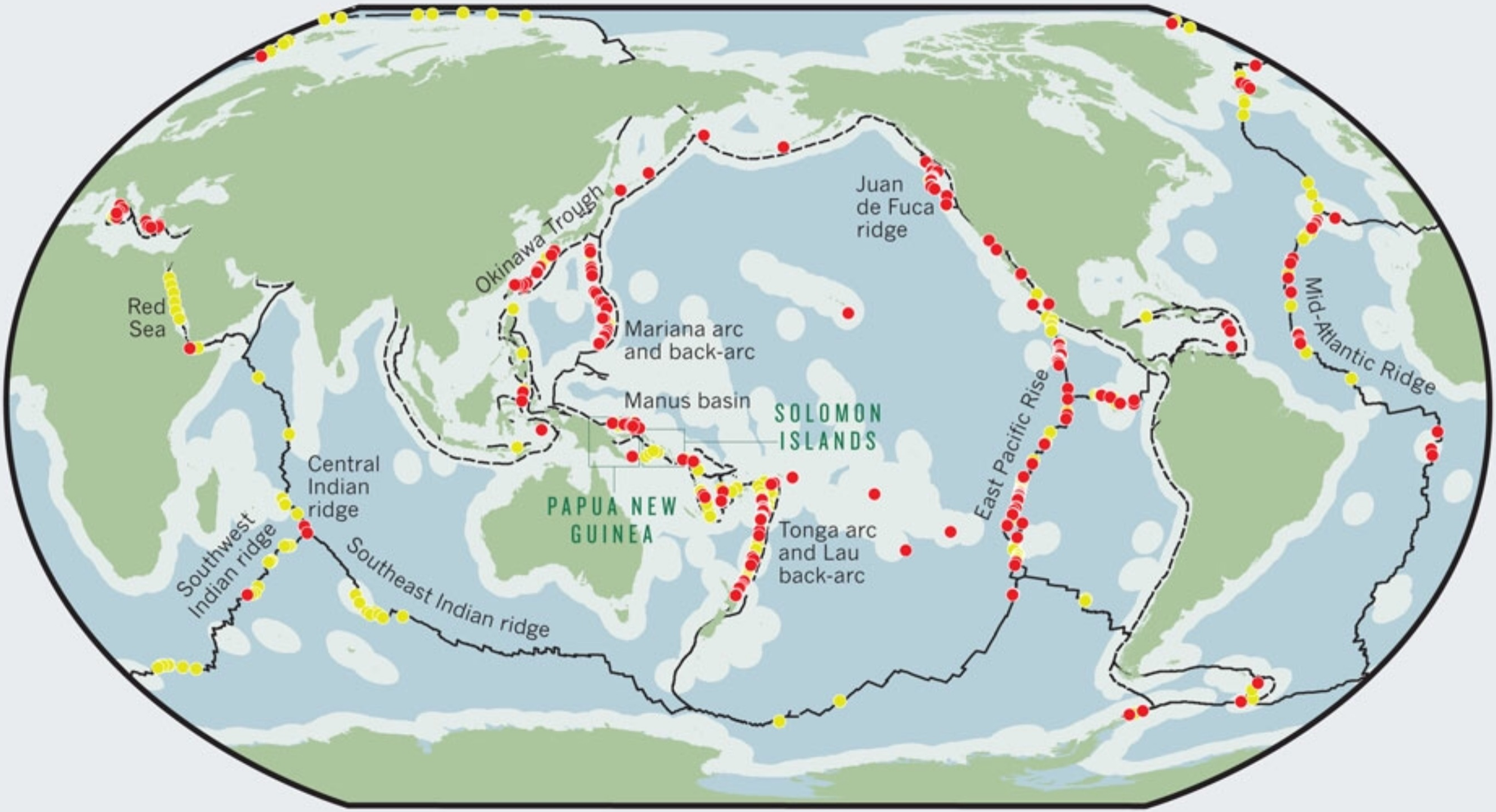
Preview this:

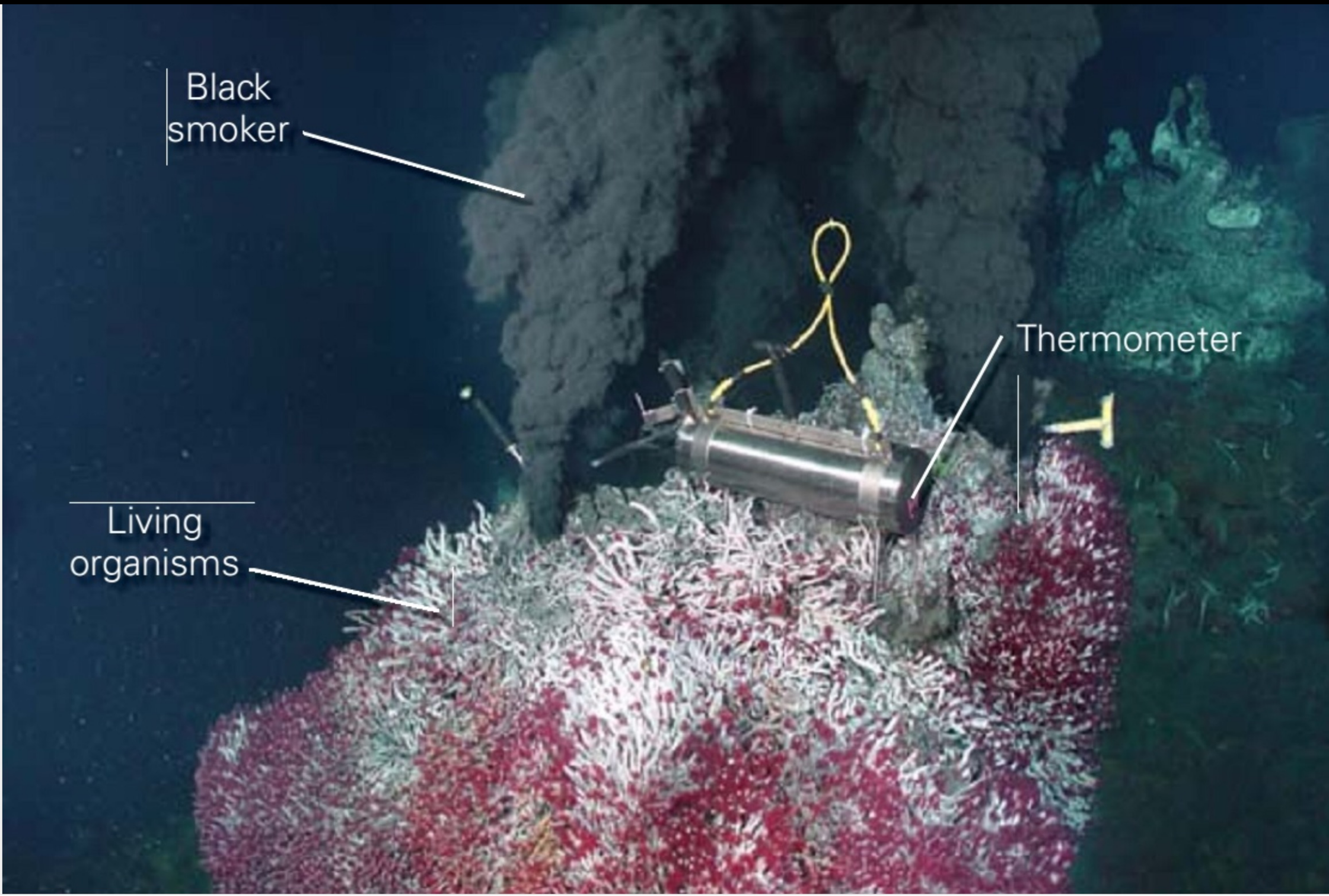

Sunlight and heat
Termite mounds
Insects
Fungi
Rotting log
Bacteria
Protozoans
Plankton
Algae

GLOBAL DISTRIBUTION OF HYDROTHERMAL VENT FIELDS

Most deep-sea vents are in volcanically active areas. Many are found in international waters, or in seas belonging to countries that are still developing deep-sea conservation policies.

● Active ● Unconfirmed — Ridge -- Trench ☐ Exclusive economic zones ☐ International waters





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t Plate Boundaries and Sea-Floor Spreading ~ Learning Geology

Cl^- Cl^-

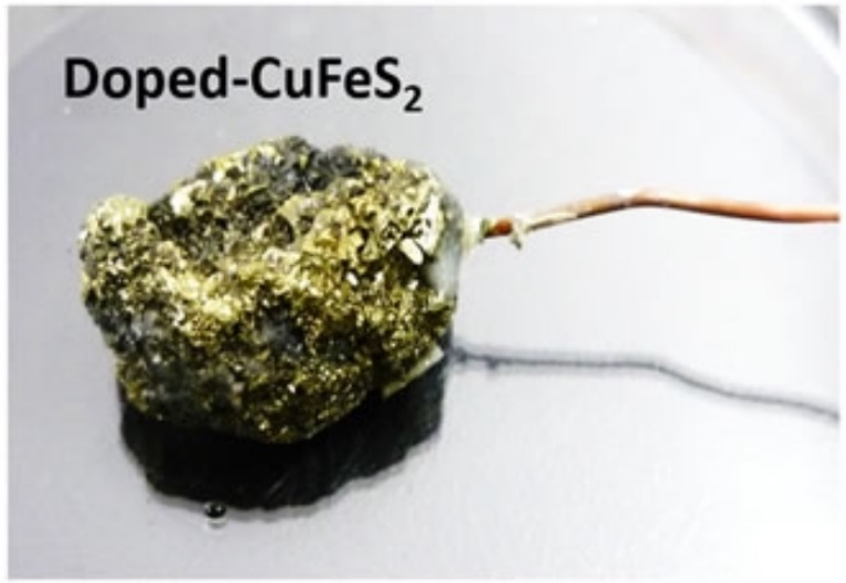
Na^+

Na^+

Cold, Oxidative Zone

Hot, Reductive Zone

H_2S, H_2, Fe^{2+}



Natural mineral can convert energy between heat, electricity, and chemical energy.

CO_2

CO, CH_4,

NO_3^-

NH_3

CO_2

Biomass

e^-

e^-

e^-

e^-

e^-

e^-

H_2S

S, SO_4^{2-}

Sea water

Magma

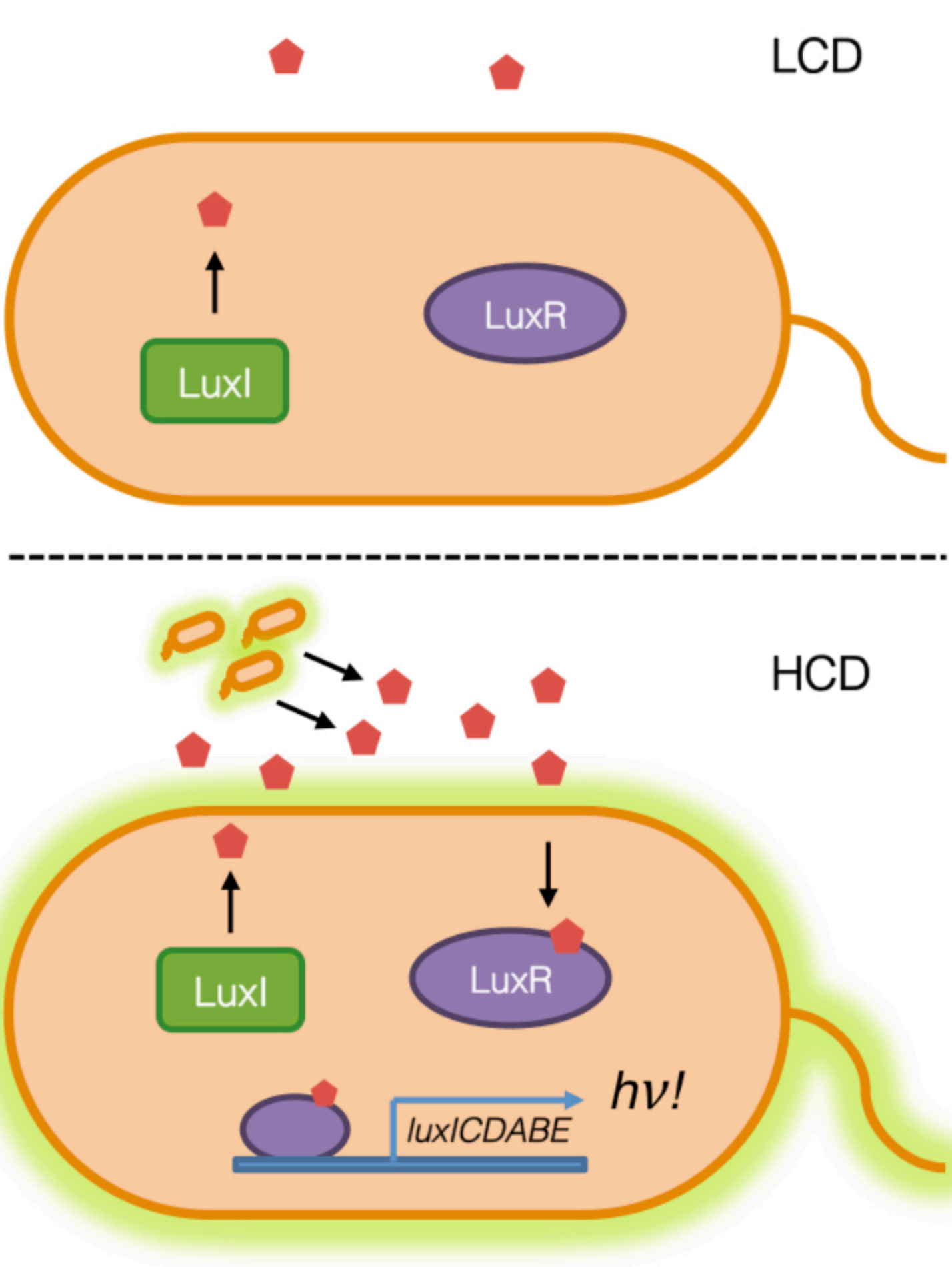
Energy for life

- Chemotroph
- Phototroph
- Electrotroph

Chemotroph
ALPHARD

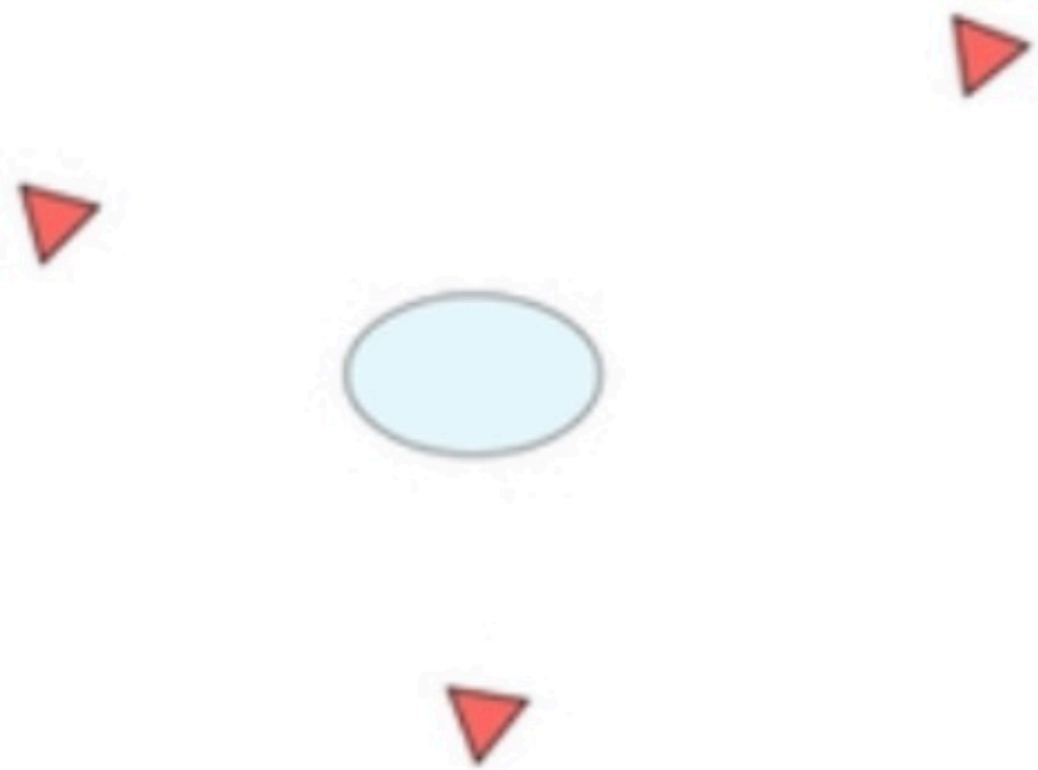
Phototroph

1400
1000
600
BASSLER
LAB


LCD
LuxR
LuxI
HCD
LuxI
LuxR
hν!
luxICDABE

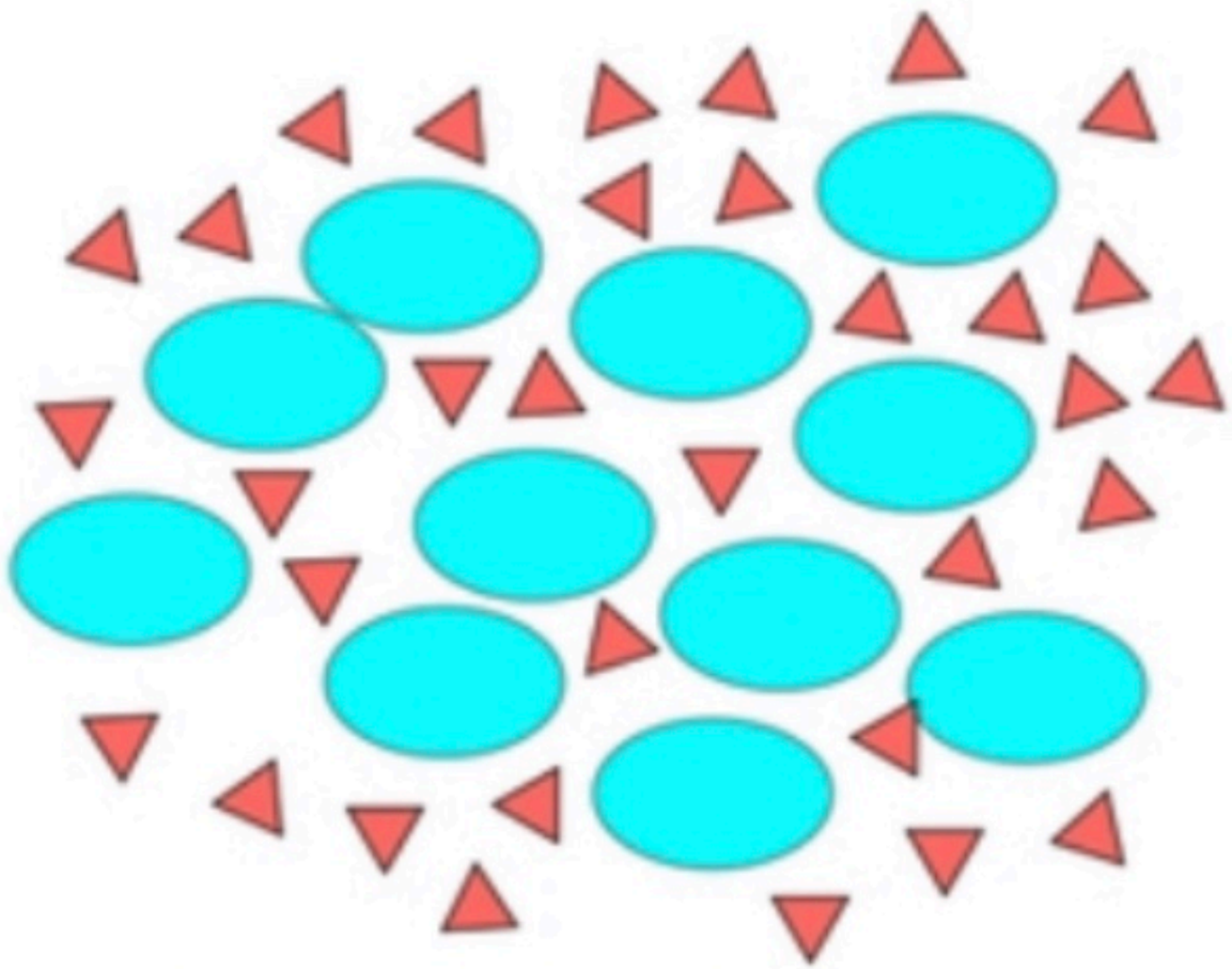
Bacterial Quorum Sensing

Low Cell Density



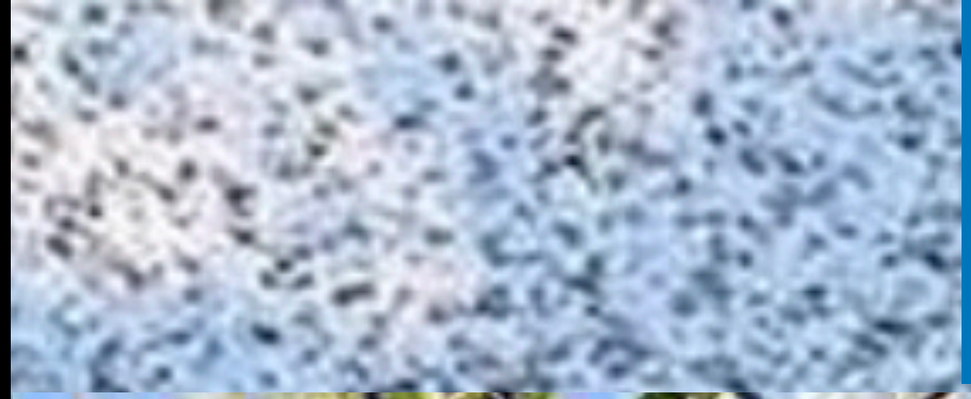
Individual Behaviors

High Cell Density



Group Behaviors

Swarming behavior in locust: From shy, solitary, to aggressive Cohesion pheromone



Journal of Applied Microbiology 2002, **92**, 759–763

A Note: Gut bacteria produce components of a locust cohesion pheromone

R.J. Dillon, C.T. Vennard and A.K. Charnley

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2001/223: received 1 August 2001, revised 14 September 2001 and accepted 13 November 2001

R.J. DILLON, C.T. VENNARD AND A.K. CHARNLEY. 2002.

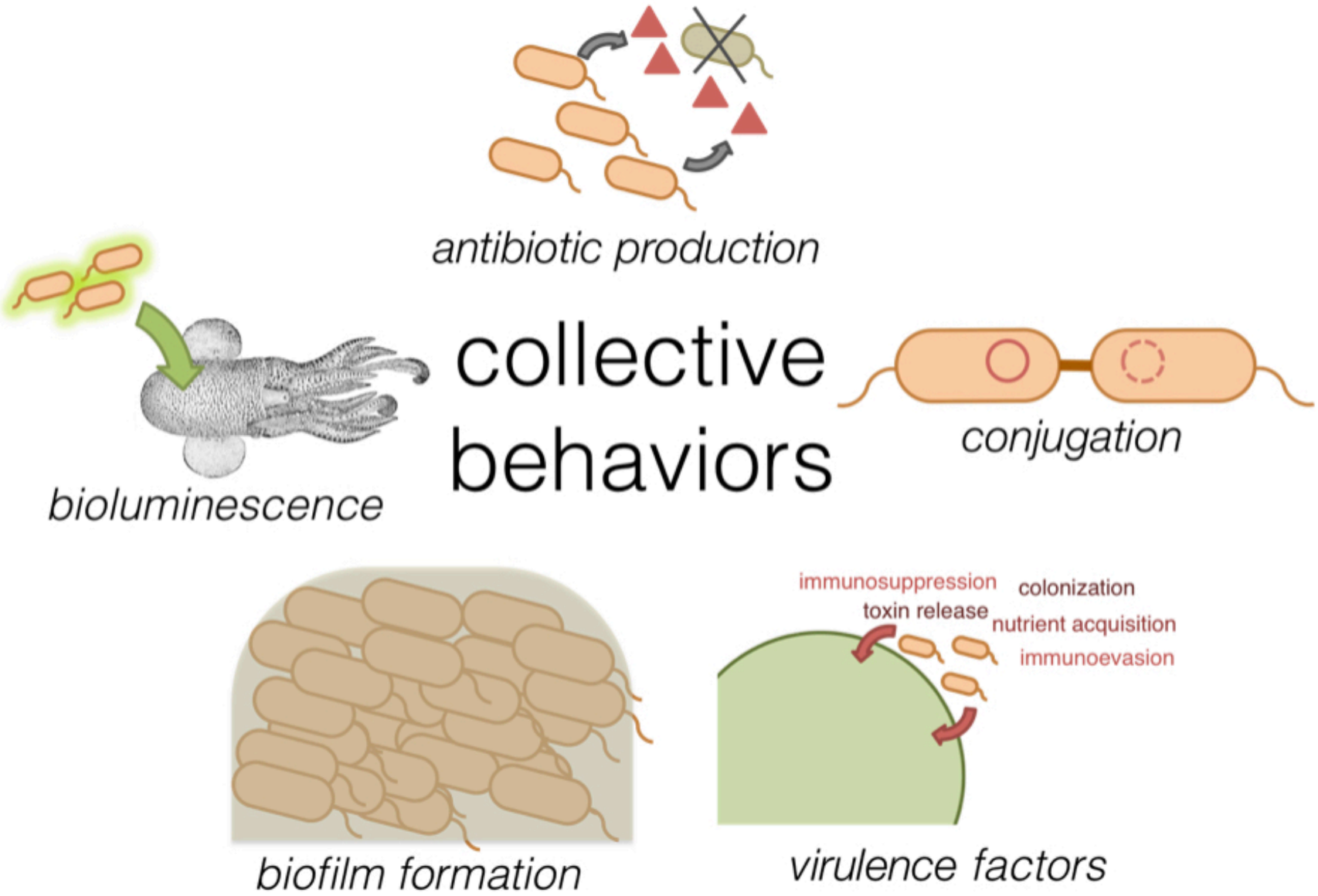
Aims: Faecal pellets from germ-free locusts were used as culture media to determine the ability of locust gut bacteria to synthesize phenolic components of the locust cohesion pheromone.

Methods and Results: Inoculation of germ-free faecal pellets with *Pantoea agglomerans*, a species commonly isolated from locusts, resulted in the release of large amounts of guaiacol and small amounts of phenol, both of which are components of the locust cohesion pheromone. Two other locust-derived species, *Klebsiella pneumoniae pneumoniae* and *Enterobacter cloacae*, also produced guaiacol from germ-free faecal pellets, but the opportunistic locust pathogen, *Serratia marcescens*, did not. The most likely precursor for guaiacol is the plant-derived vanillic acid, which is present in large amounts in the faeces of both conventional and germ-free locusts.

Conclusions: These observations are consistent with previous ones, that locust gut bacteria are responsible for the production of components of the locust cohesion pheromone.

Significance and Impact of the Study: These findings illustrate how an insect can adapt to make use of a common bacterial metabolite produced by one or more of its indigenous gut bacterial species. This observation has implications for our appreciation of insect gut

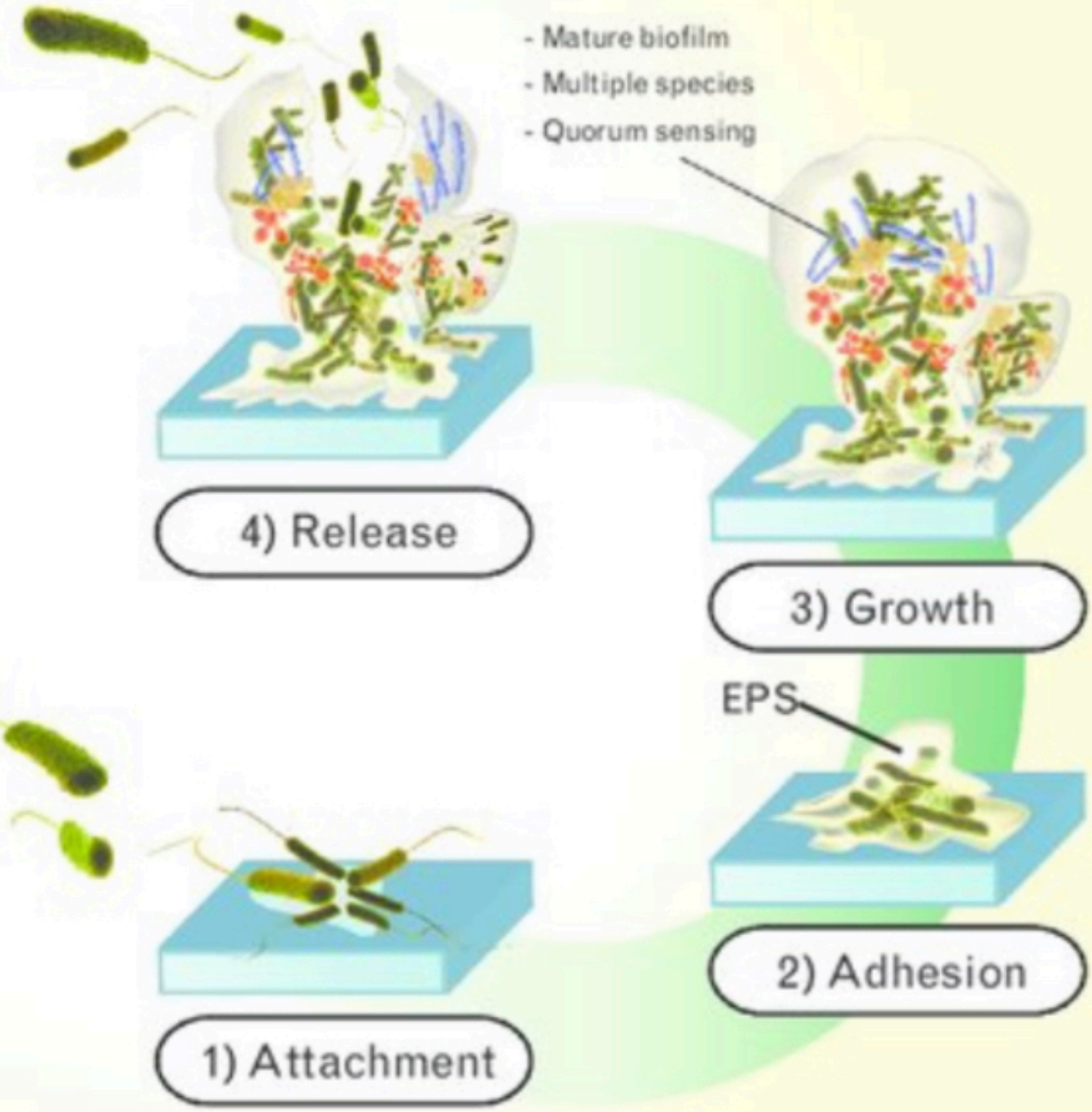
WHAT TYPES OF BEHAVIORS ARE REGULATED BY QS?



Planktonic bacteria

- Mobility
- Faster growth
- Higher virulence
- Abx susceptibility
- Demand for nutrients

Biofilm



Why single inoculum often fail, or inconsistent?

They need friends

Life outside lab is not easy

Let's work together. Synergistically!

Bhineka Tunggal Ika Tubuh Manusia

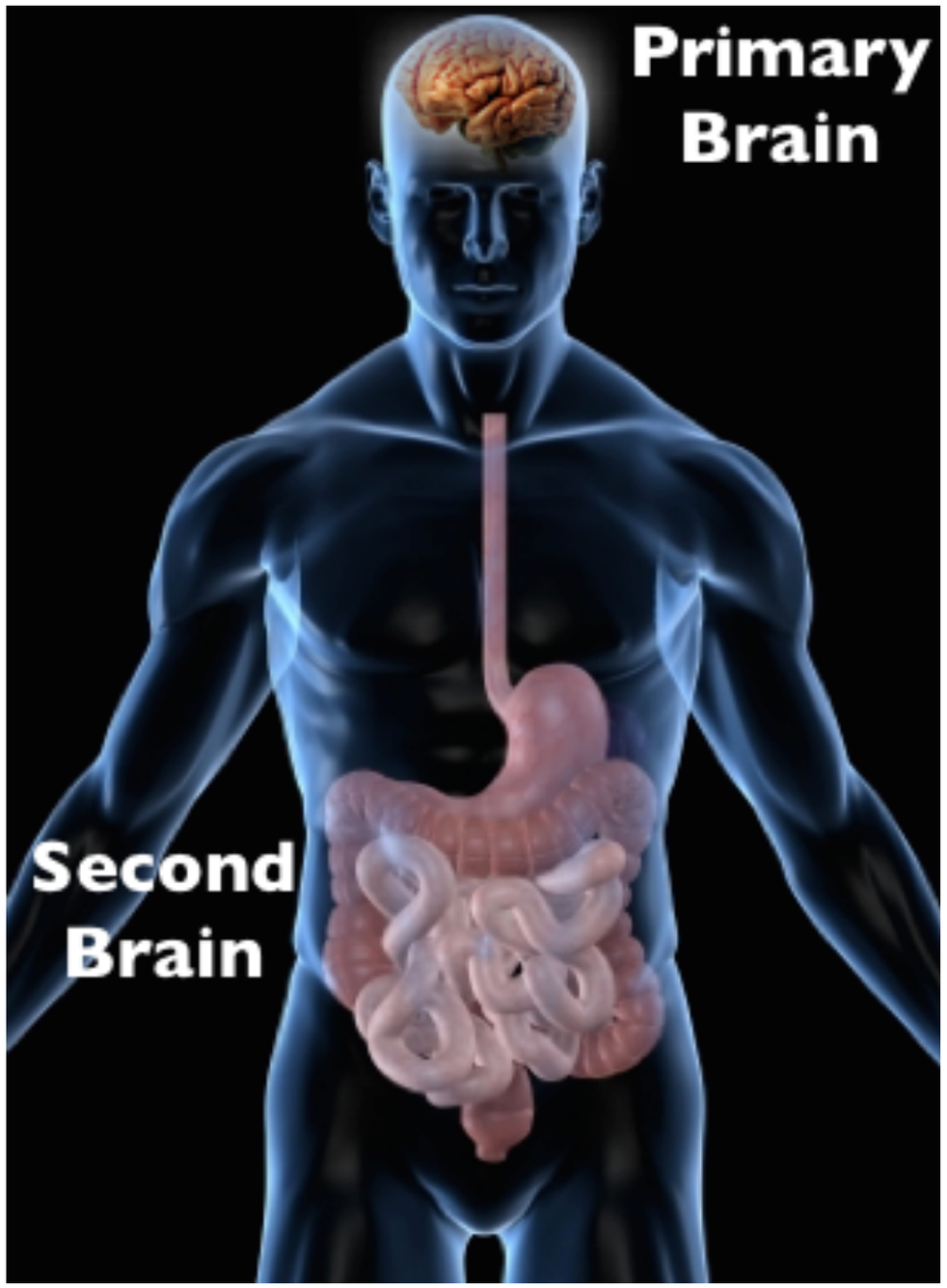
10,000,000,000,000 cells

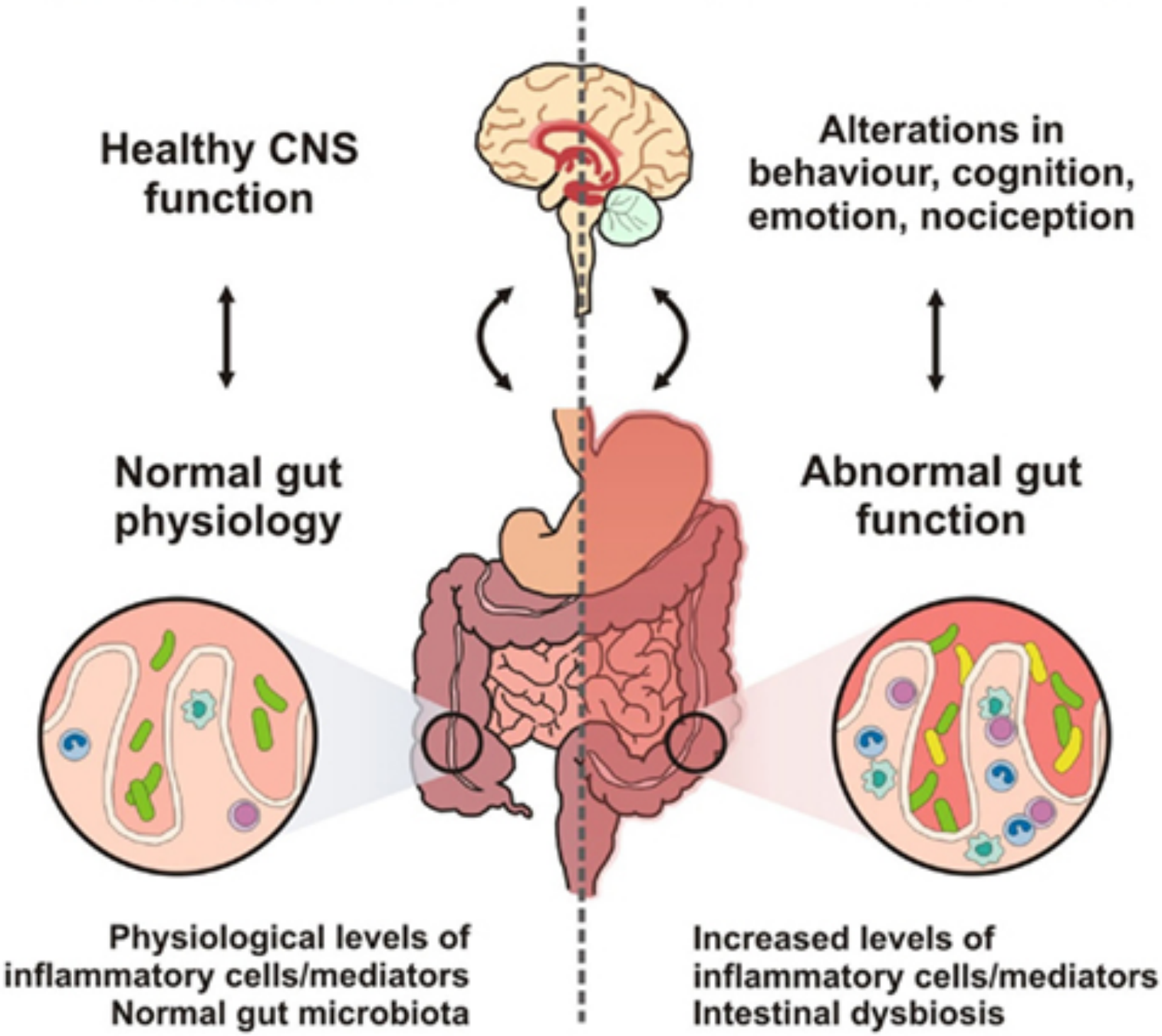
Bacteria

- Microbiota in human ~**10^{14} cells**
- 100x genes in the human genome
- More prokaryotes than eukaryotes!
- Colon is a “microbial metropolitan” >1000 bacterial strains (10^{12} cells per gram feces)

Human Microbiome:
90% are microbial cells

Brain-Gut Axis





You are your bacteria !

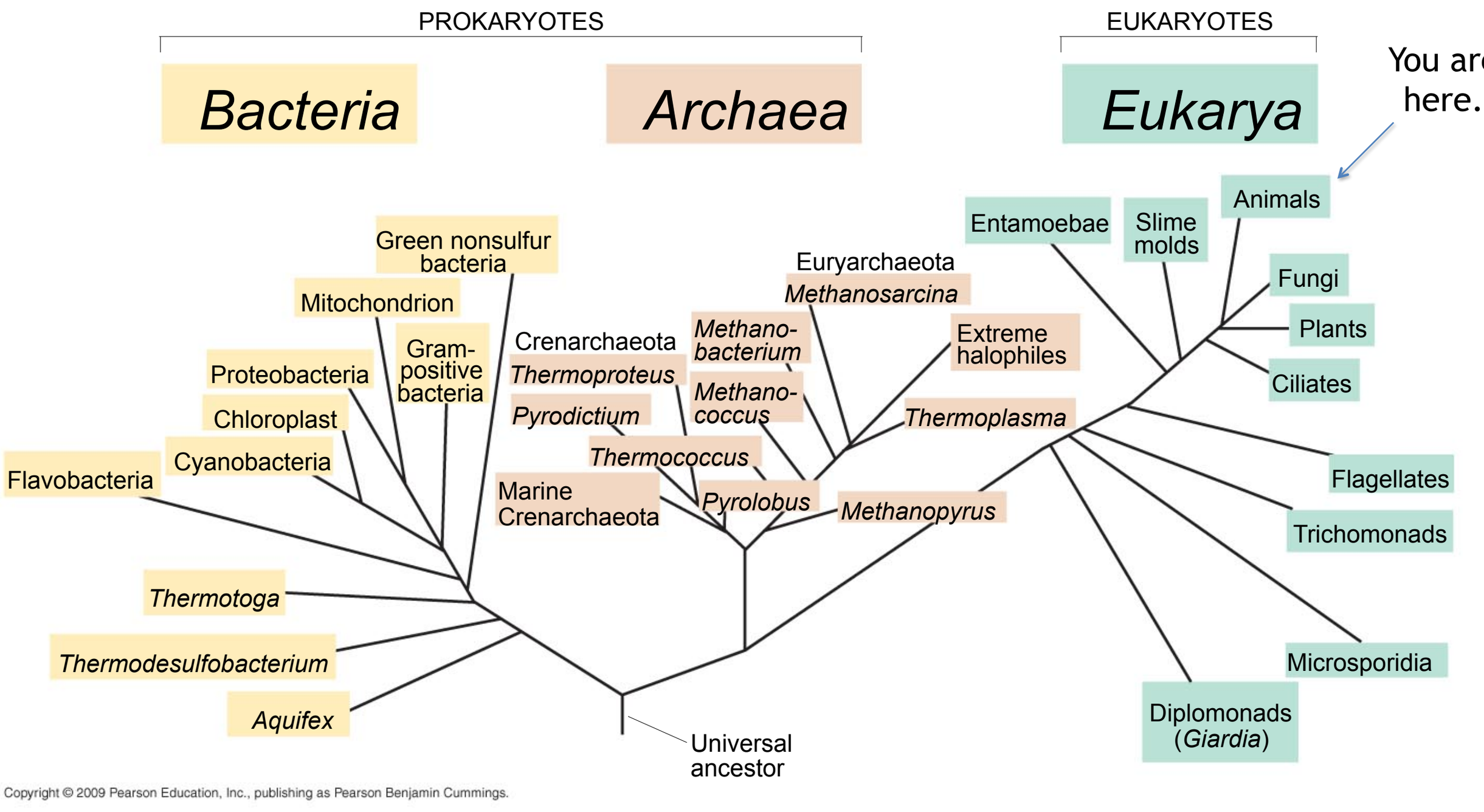
- Some of our best friends are bacteria

- For our health:

From

Obesity, Diabetes, Cancer, Anxiety, to Autism

Universal Phylogenetic Tree



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Carl Woese, Professor

Carl Woese was born in Syracuse, New York on July 15, 1928. Woese attended Deerfield Academy in Massachusetts. He received a bachelor's degree in mathematics and physics from Amherst College in 1950. During his time at Amherst, Woese took only one biology course (Biochemistry, in his senior year) and had "no scientific interest in plants and animals" until advised by William M. Fairbank, then an assistant professor of physics at Amherst, to pursue biophysics at Yale.[11]

In 1953, he completed a Ph.D. in biophysics at Yale University, where his doctoral research focused on the inactivation of viruses by heat and ionizing radiation.[12][13] He studied medicine at the University of Rochester for two years, quitting two days into a pediatrics rotation.[13] Then he became a postdoctoral researcher in biophysics at Yale University investigating bacterial spores.[14] From 1960–63, he worked as a biophysicist at the General Electric Research Laboratory in Schenectady, New York.[12][15] In 1964, Woese joined the microbiology faculty of the University of Illinois at Urbana–Champaign, where he focused on Archaea, genomics, and molecular evolution as his areas of expertise.[10][12][15] He became a professor at the University of Illinois at Urbana–Champaign's Carl R. Woese Institute for Genomic Biology, which was renamed in his honor in 2015, after his death.[15]