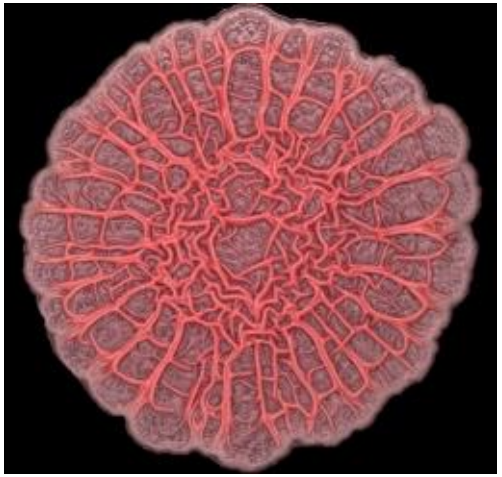
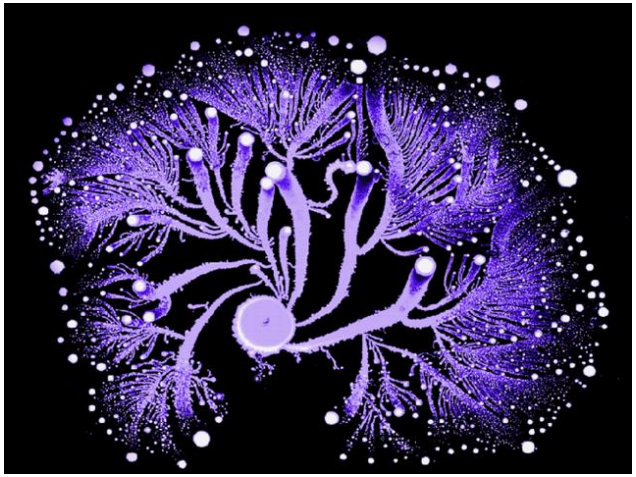
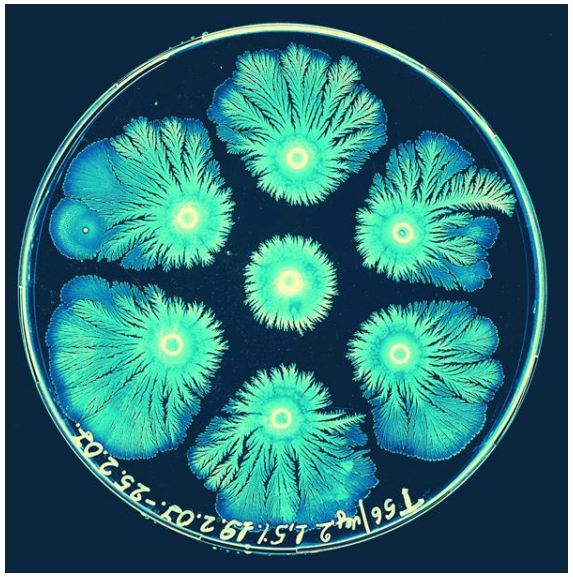
Bacterial Colonies



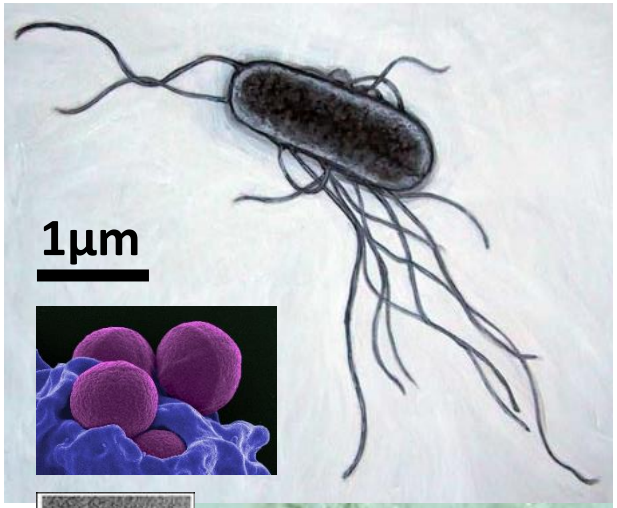


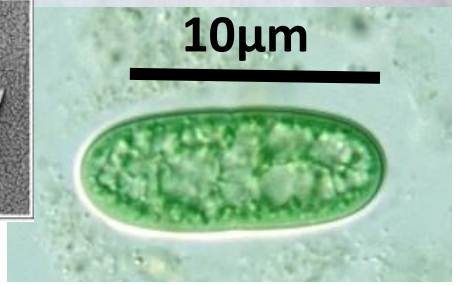


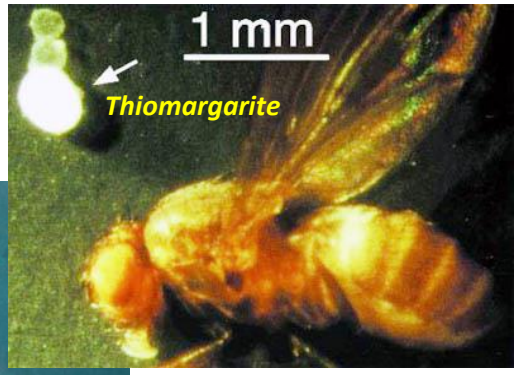
<u>In the laboratory</u>, bacteria are usually grown using solid (*agar plates*) or liquid nutritious media.

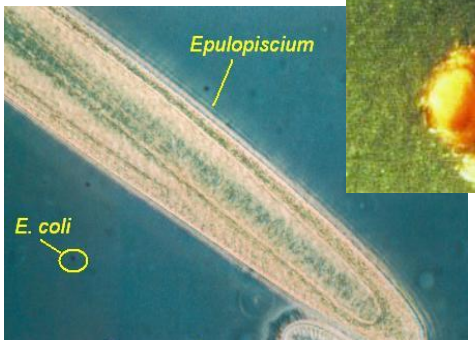
Bacteria Size

- **Average ~1 micrometer: an average-size rod bacterium (ex. *Escherichia coli* found in your intestine) is about 2-3 µm long and 0.5-1µm across; the spherical cells of *Staphylococcus aureus* are up to 1 µm in diameter.**
- **Smallest ~0.1 micrometer: *Mycoplasma pneumonia* are just ~0.1-0.25 µm across.**
- **Large ~10 micrometers: *cyanobacterium Synechococcus* averages 6 µm by 12 µm.**
- **Giant (more than half a millimeter!) bacteria can be visible with the unaided eye: *Thiomargarite namibiensis* averages 750 µm in diameter; the rod-shaped *Epulopsicium fishelsoni* is 80 µm in diameter by 600 µm in length.**

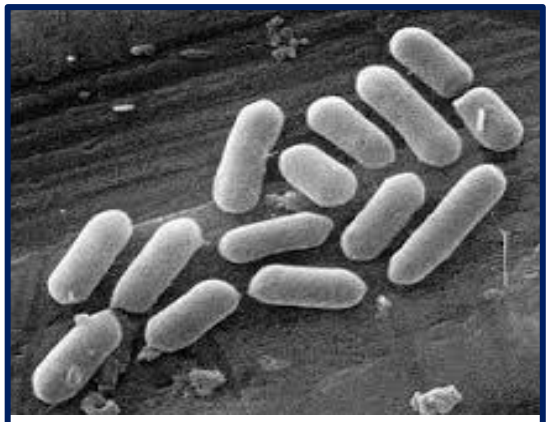




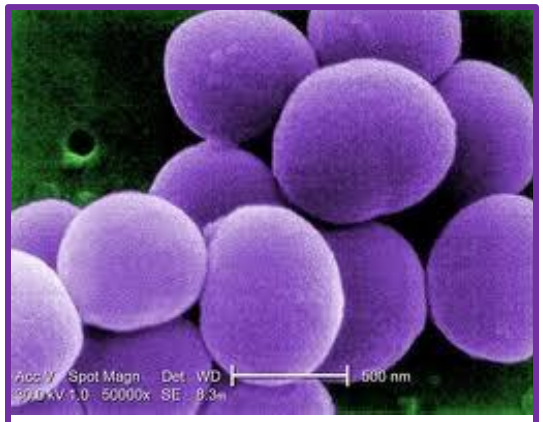




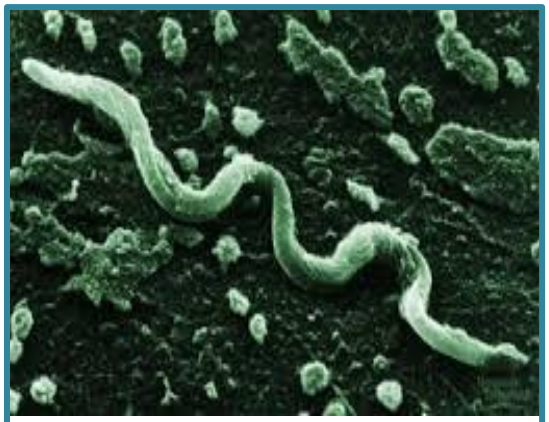
Basic Bacteria Shapes



Bacilli
(buh-sill-eye)
rod shaped



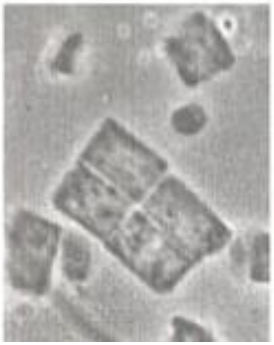
Cocci
(cox-eye)
round shaped

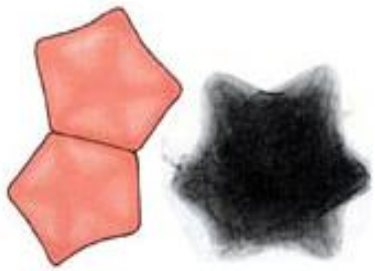


Curve shaped
(vibrio, spirilla, spirochete)

- **Some unusual shapes:**
  - **Salt-loving *Haloquadratum* and *Haloarcula***
  - **Unique star-shaped *Stella***

square

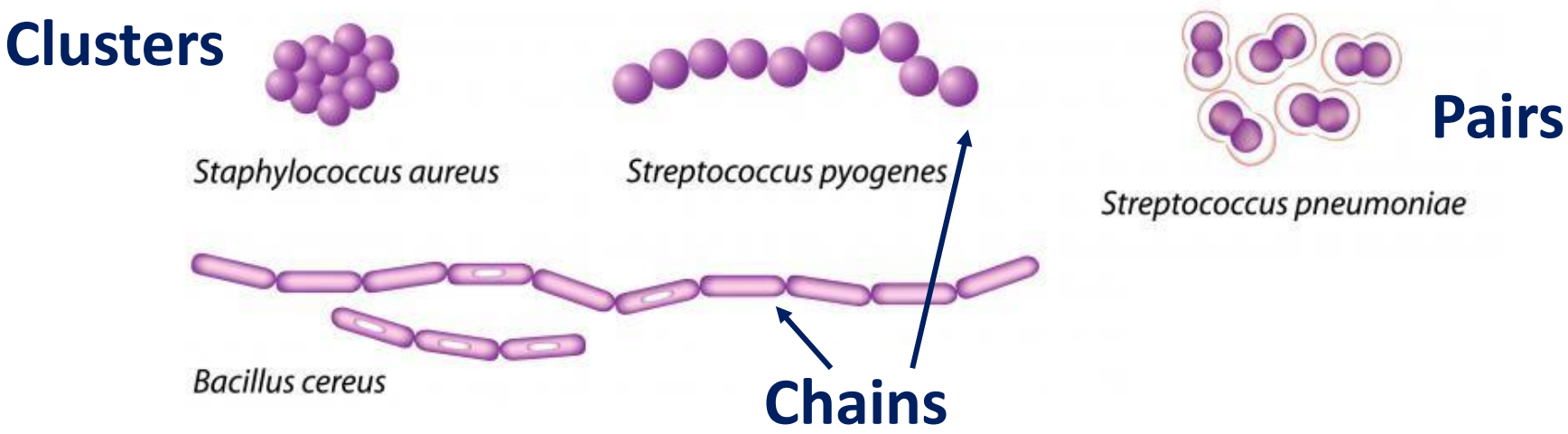




star-shaped

Do bacteria get together?

Many bacterial species exist simply as single cells, while others associate in characteristic patterns:



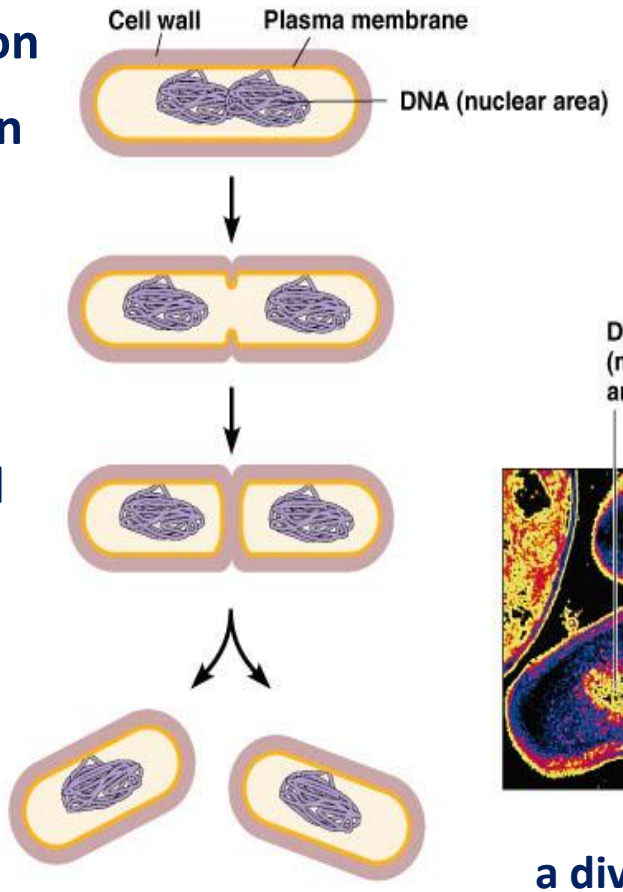
Many bacteria can form aggregated structures called <u>biofilms</u>:

- **Organisms in biofilms often display substantially different properties from the same organism in the individual state.**
- **Biofilms can communicate information about population size and metabolic state.**

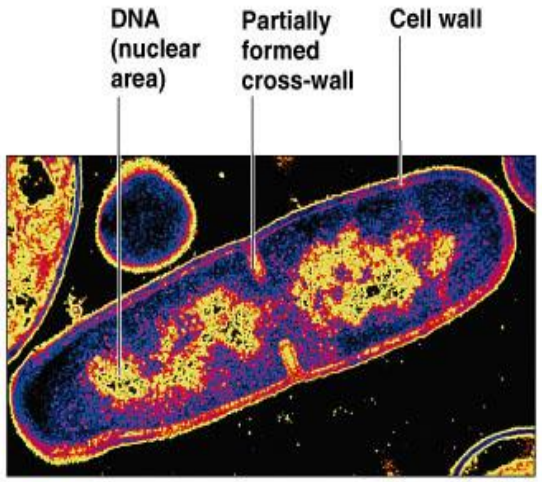
Reproduction

Bacteria grow to a fixed size and then reproduce through binary fission: bacterial cell divides in half, producing two genetically identical *clone* daughter cells.

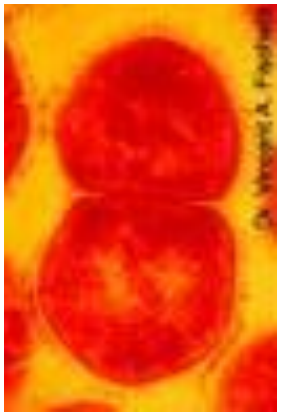
1. Cell elongation and DNA replication
2. DNA separation
3. Cross-wall formation
4. Daughter cells separation



Under optimal conditions, bacteria can grow and divide extremely rapidly: bacterial populations can double as quickly as every 9.8 minutes.

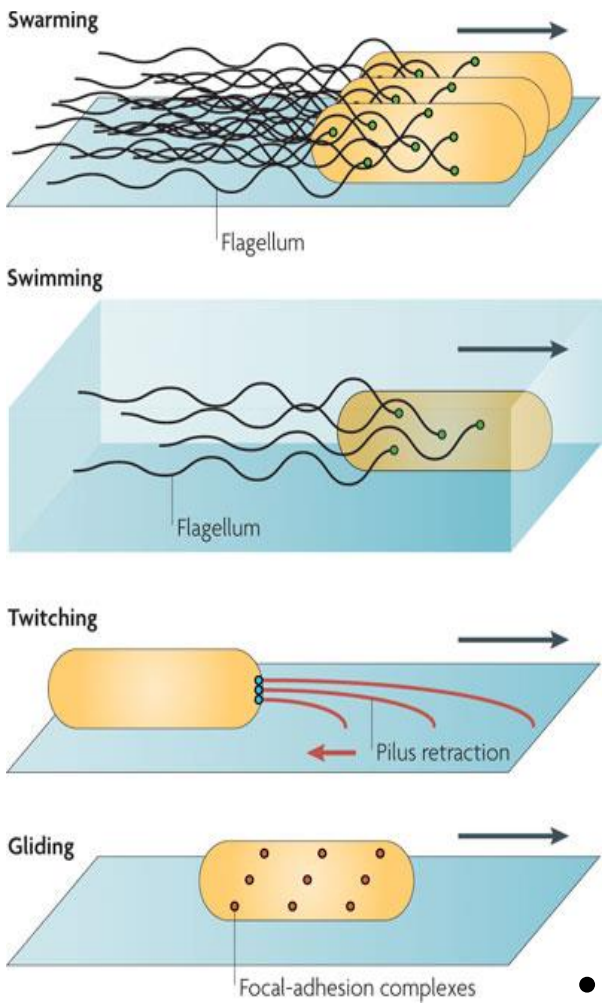


micrograph of a dividing bacterial cell



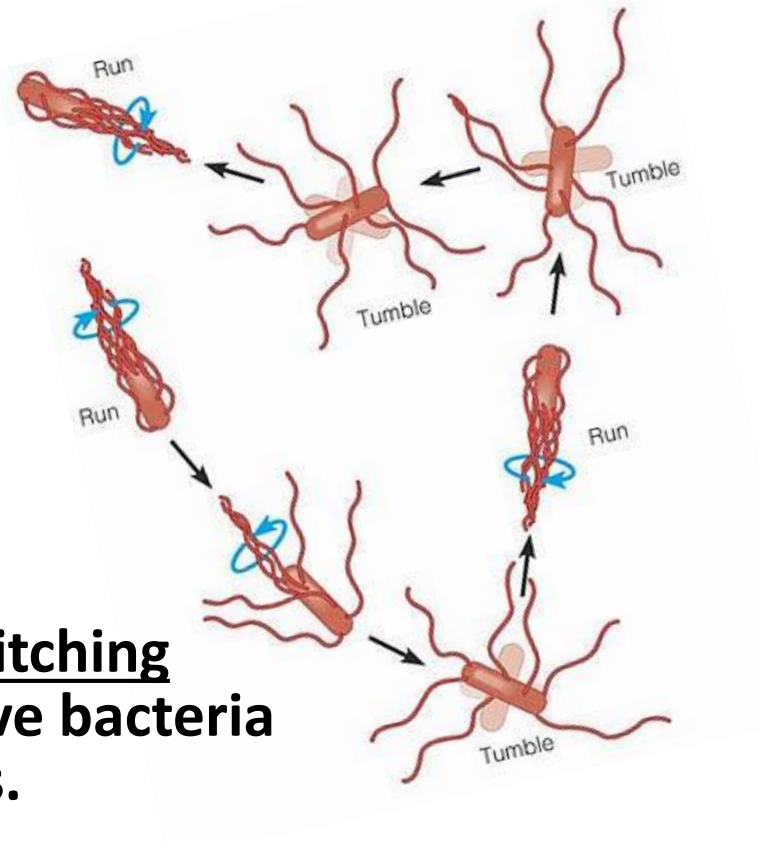
Can bacteria move?

Many bacteria can move using a variety of mechanisms:



- *Flagella* are used for swimming through fluids... as well as for "run and tumble".

(...swimming bacteria can move near 10 body lengths per second and a few as fast as 100; this makes them at least as fast as fish, on a relative scale though...)



- Gliding and twitching (using *pili*) move bacteria across surfaces.
- Changes of *buoyancy* allow vertical motion.

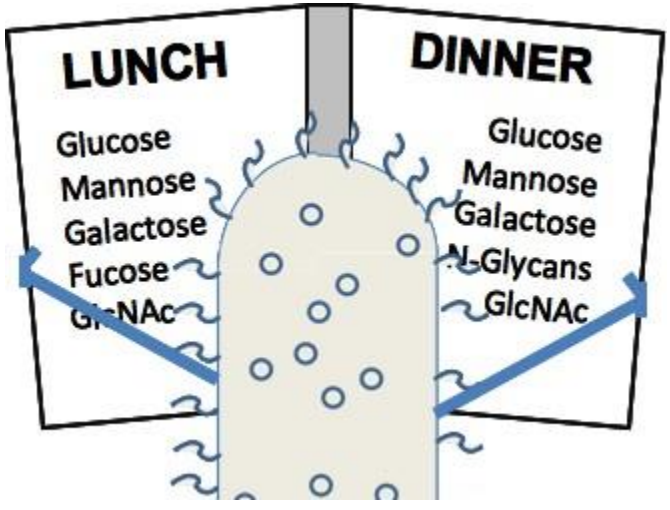
What do bacteria eat?

Autotrophic bacteria **create their own food**:

- Some make food from sunlight by **photosynthesis** - involves the use of *sunlight*, *carbon dioxide* and *water* to create energy and building materials.
- Other manufacture food through **chemosynthesis** - the process of using *water*, *carbon dioxide* and *other inorganic chemicals* like ammonia, sulfur, phosphorus, nitrogen, and metallic elements, to synthesize organic components.

Heterotrophic bacteria must **consume organic compounds**:

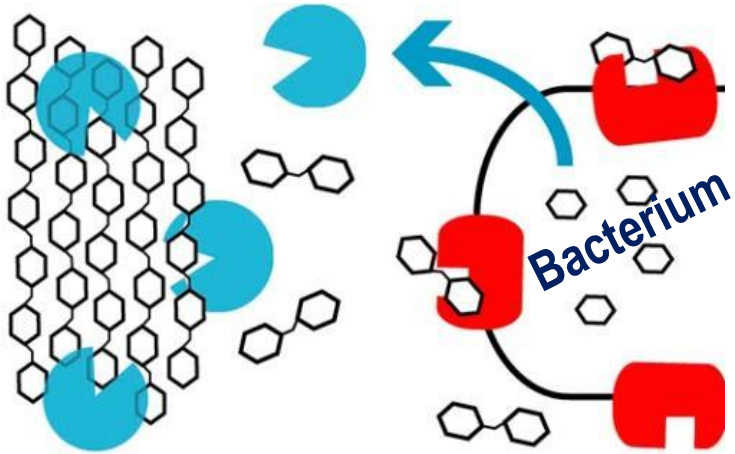
- They eat **other organisms** and absorb **dead organic material** from its surroundings.
- Some of these *parasitic* bacteria feed by **killing their hosts**, while others called *symbiotic* **coexist with or even help** their hosts.



How do bacteria digest food?

Heterotrophic bacteria employ <u>extra-cellular digestion</u>.

- **Make proteins called *enzymes* inside the cell.**
- **Enzymes travel through the cell wall into the surrounding medium, catch the food and break it down into tiny subunits (most bacteria need *oxygen* to do it).**
- **Resulting simple compounds are taken into the bacteria cell.**



- **Each <u>specific food</u> requires a <u>specific enzyme</u>:**
  - **Some bacteria produce many kinds of enzymes and can eat many kinds of foods.**
  - **Other bacteria have few enzymes and are able to digest very few kinds of food (however they can still live off a given food by growing where other bacteria have already broken the food down).**

Unusual Foods

Nuclear Waste

Geobacter sulfurreducens changes the soluble form of uranium to a solid form, which is easier to recover during clean up of contaminated water...

Crude Oil

Several types of bacteria naturally consume oil (*Alcanivorax* naturally appeared and consumed oil plumes generated from the 2010 Deepwater Horizon spill), but an engineered form of *Pseudomonas putida* is capable of doing it in a very efficient manner!

The Titanic

Two miles below the ocean surface, bacteria deemed *Halomonas Titanicae* are consuming the steel of the RMS Titanic as a fuel source (the only material the bacteria stay away from on the ship are brass items: brass contains copper, which quickly kills most bacteria).

Caffeine

Given caffeine as it's only source of nutrition, *Pseudomonas putida CBB5* can metabolize it into carbon dioxide and ammonia...