Is it possible for bacteria to live off of metal and eat plastic?

http://www.ontariogenomics.ca/education/episode8.asp

What are bacteria?

Bacteria are microbes, or microorganisms, which are single celled organisms too small to see with the naked eye. Bacteria have no nucleus; their genome is made of one single chromosome (whereas humans have 46 chromosomes). They divide by asexual reproduction; Escherichia coli, which live in the human digestive tract and help make vitamin K, divide about every twenty minutes. Some bacteria – like Bacillus anthracis, which causes anthrax – can form spores when they run out of food, allowing them to dry up but stay "alive" until they find themselves in enough food that they can survive and multiply. Bacteria come in many shapes: rods, spheres, curvy. Some, called aerobes, grow in the presence of oxygen while others, called anaerobes, do not require oxygen to survive.

Black-out causing bacteria?
Clumps of bacteria growing in a Petri dish.

Can bacteria "live on" metals?

Bacteria can live practically anywhere. Certain bacteria – including sulfate-reducing bacteria that cause a rotten egg smell – prefer to live on rusting or corroding metals. These bacteria grow as a "biofilm" - a thin layer of bacteria that coat the surface of the metal. "Biocorrosion," the corrosion of metal by biofilms, occurs when the metal reacts with, and falls apart as a result of the bacteria living on it. Biocorrosion is a huge global industrial problem, with annual losses in the United States estimated at $276 billion.

Isolating the cuprit
Bacteria living on underground cables eat through plastic covering the wires.

Can bacteria "eat" plastic?

Originally, plastics were made from petroleum-based compounds, using non-renewable resources and casting off toxic by-products in the process. More recently, however, there has been a movement towards biodegradable plastics – plastics made of potato or corn starch – that can be broken down by bacteria and other microorganisms into organic waste.

Some bacteria can eat toxic materials. A group of researchers in Ireland recently discovered a strain of soil bacteria that can eat styrene – a toxic byproduct from Styrofoam that causes lung problems and muscle weakness – and convert it into a different kind of non-toxic plastic. The process of metabolising a toxic substance into a useful compound is called “biocatalysis.”

So...

Yes, it is possible for some bacteria to live on metal and live off of the corrosion by-products. It is also possible for bacteria to eat plastics or plastic-related compounds, depending on what the plastic is made of and what kind of bacteria are feeding on it.

Is it probable to use plastic-eating bacteria to get rid of waste?

What kind of toxic substances can bacteria “eat”?

Bacteria can turn a number of toxic substances into non-toxic ones; this process is referred to as “biodegradation.” Biodegradation is an area of active research in marine ecology. There are several types of bacteria that live in the ocean and eat oil – petroleum hydrocarbons – from oil tanker spills. Some research has found that adding other nutrients to oil spills can speed up the growth of bacteria at the spill and therefore speed the “removal” of the oil by the bacteria.

Other types of bacteria can biodegrade cyanide. Cyanide is a byproduct of plastics manufacture, aluminum processing, and is contained in cigarette smoke. Inhaling cyanide gas can cause poisoning including long-term heart and brain damage, and death. Certain soil bacteria can turn cyanide into harmless carbon dioxide or ammonia.

More black-out causing bacteria

More bacteria growing in a Petri dish.

Can we use bacteria to clean up the environment?

“Bioremediation” involves using biological organisms like bacteria to solve an environmental problem such as contaminated soil or groundwater. Bacteria and other microbes are constantly breaking down organic matter. When their habitat becomes polluted, some microbes die while others that are capable of eating the pollutant may survive. Bioremediation works by giving these microbes nutrients, oxygen, and any other conditions that would encourage their rapid growth. Cleaning oil spills with marine bacteria is one type of bioremediation.

Bioremediation does not work for all types of pollution. For example, sites where chemicals are found at too high of a concentration will kill most microbes. However, bioremediation does provide a technique for cleaning up pollution by enhancing the same processes that occur in nature. Bioremediation can be safer and less expensive than other methods such as burning or burying contaminated materials.

So...

Yes, it is probable to use bacteria to get rid of waste. Backyard compost piles do just that. Much research is ongoing to further understand how bacteria and other microbes metabolise certain compounds. At the same time, research has developed eco-friendlier materials that are more easily degraded, such as biodegradable plastics.

- Audrey M. Huang, Ph.D.

Want to read and learn more?

To learn more about bacteria, visit the link: http://www.bacteriamuseum.org/

To learn more about what's new in the world of microbiology, including educational activities and some movie clips, visit the links:
http://www.microbeworld.org/home.htm and
http://www.microbeworld.org/htm/aboutmicro/abt_start.htm

To learn more about the relationship between microbes and the environment, visit the link: http://commtechlab.msu.edu/sites/dlc-me/

To learn more about bioremediation efforts and bioremediation research, visit the links: http://water.usgs.gov/wid/html/bioremed.html and
http://www.lbl.gov/NABIR/

To download the U.S. Environmental Protection Agency's Citizen's Guide to Bioremediation, click the link:
http://www.epa.gov/swertio1/download/citizens/bioremediation.pdf

To read about OGI funded microbiology projects, visit the link:
http://ontariogenomics.ca/gc/ogi/researchPrograms/projectDetailOGI.asp?id=c2p68&l=e

Visit the offical ReGenesis website here.

TheRecord.com http://news.therecord.com/article/354201

WCI student isolates microbe that lunches on plastic bags

DAVID BEBEE, RECORD STAFF

KAREN KAWAWADA
RECORD STAFF

WATERLOO

Getting ordinary plastic bags to rot away like banana peels would be an environmental dream come true.

After all, we produce 500 billion of them a year worldwide, and they take up to 1,000 years to decompose. They take up space in landfills, litter our streets and parks, pollute the ocean and kill the animals that eat them.

Now a Waterloo teenager has found a way to make plastic bags degrade faster -- in three months, he figures.

Daniel Burd's project won the top prize at the Canada-Wide Science Fair in Ottawa. He came back with a long list of awa
$10,000 prize, a $20,000 scholarship, and recognition that he has found a practical way to help the environment.

Burd, 16, a Grade 11 student at Waterloo Collegiate Institute, got the idea for his project from everyday life.

"Almost every week I have to do chores and when I open the closet door, I have this avalanche of plastic bags falling on
"One day, I got tired of it and I wanted to know what other people are doing with these plastic bags."

The answer: not much. So he decided to do something himself.

He knew plastic does eventually degrade, and figured microorganisms must be behind it. His goal was to isolate the mic
break down plastic -- not an easy task because they don't exist in high numbers in nature.

First, he ground plastic bags into a powder. Next, he used ordinary household chemicals, yeast and tap water to create a
encourage microbe growth. To that, he added the plastic powder and dirt. Then the solution sat in a shaker at 30 degree

After three months of upping the concentration of plastic-eating microbes, Burd filtered out the remaining plastic powde
culture into three flasks with strips of plastic cut from grocery bags. As a control, he also added plastic to flasks containi
therefore dead bacterial culture.

Six weeks later, he weighed the strips of plastic. The control strips were the same. But the ones that had been in the liv
weighed an average of 17 per cent less.

That wasn't good enough for Burd. To identify the bacteria in his culture, he let them grow on agar plates and found he
microbes. He tested those on more plastic strips and found only the second was capable of significant plastic degradatio

Next, Burd tried mixing his most effective strain with the others. He found strains one and two together produced a 32 p
his plastic strips. His theory is strain one helps strain two reproduce.

Tests to identify the strains found strain two was Sphingomonas bacteria and the helper was Pseudomonas.

A researcher in Ireland has found Pseudomonas is capable of degrading polystyrene, but as far as Burd and his teacher l
-- and they've looked -- Burd's research on polyethelene plastic bags is a first.

Next, Burd tested his strains' effectiveness at different temperatures, concentrations and with the addition of sodium ace
source of carbon to help bacteria grow.

At 37 degrees and optimal bacterial concentration, with a bit of sodium acetate thrown in, Burd achieved 43 per cent de
weeks.

The plastic he fished out then was visibly clearer and more brittle, and Burd guesses after six more weeks, it would be g
that yet.

To see if his process would work on a larger scale, he tried it with five or six whole bags in a bucket with the bacterial cu
too.

Industrial application should be easy, said Burd. "All you need is a fermenter . . . your growth medium, your microbes ar

The inputs are cheap, maintaining the required temperature takes little energy because microbes produce heat as they w
outputs are water and tiny levels of carbon dioxide -- each microbe produces only 0.01 per cent of its own infinitesimal w
dioxide, said Burd.

"This is a huge, huge step forward . . . We're using nature to solve a man-made problem."

Burd would like to take his project further and see it be used. He plans to study science at university, but in the meantin
things such as student council, sports and music.

"Dan is definitely a talented student all around and is poised to be a leading scientist in our community," said Menhenne
science fair team but says he only helped Burd with paperwork.

Other local students also did well at the national science fair.

Devin Howard of St. John's Kilmarnock School won a gold medal in life science and several scholarships.

Mackenzie Carter of St. John's Kilmarnock won bronze medals in the automotive and engineering categories.

Engineers Without Borders awarded Jeff Graansma of Forest Heights Collegiate a free trip to their national conference in

Zach Elgood of Courtland Avenue Public School got honourable mention in earth and environmental science.

kkawawada@therecord.com