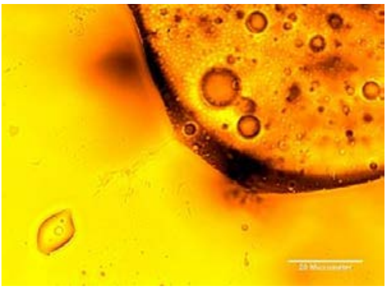
Oil-eating Microbes

In the Gulf of Mexico

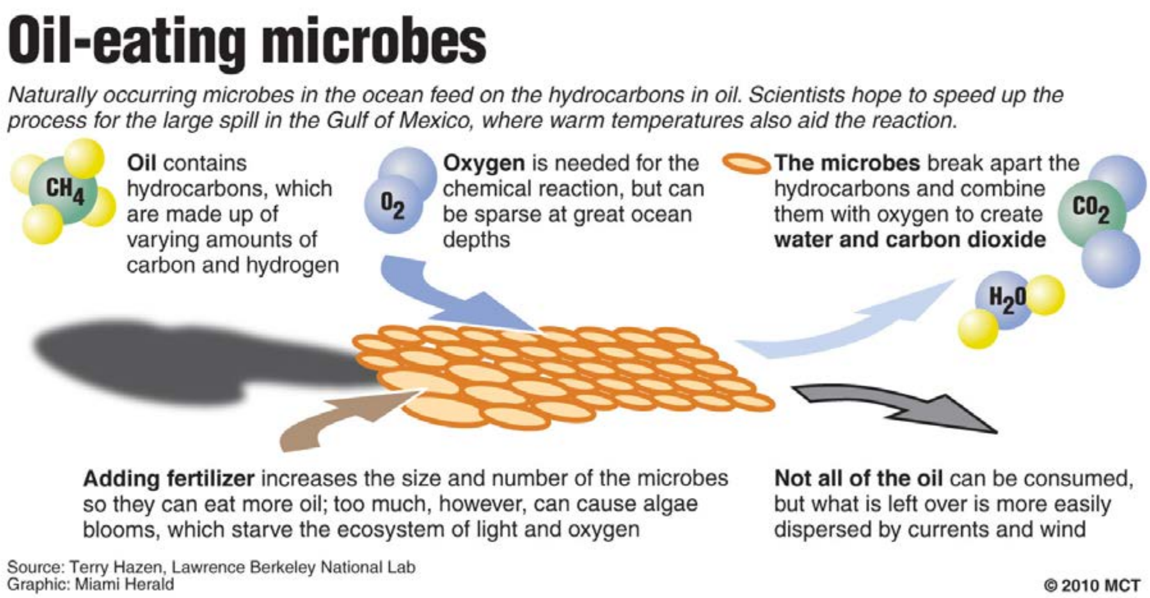
A Deep-C Consortium Fact Sheet

Microbe Munchers Helped in Cleanup of 2010 Deepwater Horizon Oil Spill



What are microbes?

Microbes are tiny, single-cell organisms too small to be seen with the naked eye. Since oil is a great food source for microbes, many different types – primarily bacteria and fungi – have evolved to break down oil into carbon dioxide and water. Because oil seeps occur naturally at the seafloor, hydrocarbon-degrading microbes are present everywhere in the marine environment, especially in the oil-rich Gulf of Mexico. The majority of microbial degradation occurs by aerobic respiration, which means the oil-degrading microbes "breathe" oxygen and burn or decompose oil hydrocarbons just as humans breathe oxygen and break down food for energy.



Did you know… microbes can share their genes for oil-degrading enzymes with other microbes! This is called horizontal gene transfer (HGT).

Why are microbes so important?

Biodegradation mediated by native microbial communities is the ultimate fate of the majority of oil hydrocarbons that enter the marine environment. The 2010 Deepwater Horizon Oil Spill released light crude oil composed of a variety of compounds with varying degrees of biodegradability. Research has shown that microbes can biodegrade up to 90% of some light crude oils. Therefore, microbes were instrumental in helping clean up the oil-contaminated environment in the Gulf.

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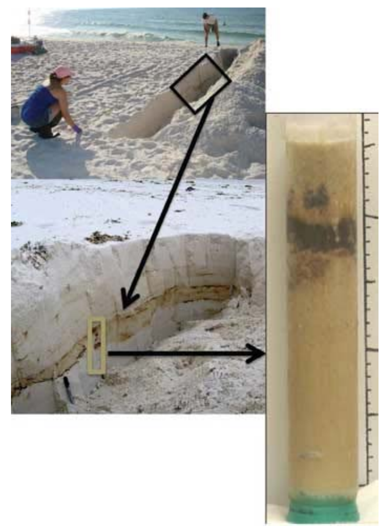
Deep-C Consortium's Research Findings

Some microbes regularly biodegrade or "eat" compounds found in oil, but we cannot rely on oil-eating microbes alone to clean up oil spills. Oil generally does not accumulate in the ocean because native microbes break it down or eat it. However, the populations of these microbes are proportional to the supply of oil naturally present on the Gulf floor. In other words, microbes follow with the principles of good business known as "supply and demand." That is, though microbes are thought to have eaten a large portion of the oil within months after the Deepwater Horizon oil spill, their "demand" in the form of consumption was not able to keep up with the rapid "supply" of oil from the well. Thus, a substantial portion of the oil reached sensitive coastal ecosystems such as beaches and marshes. Typically, when an oil spill occurs, there are not enough microbes present to degrade the oil before it causes ecological damage. While the population of microbes may eventually increase in response to a spill, other methods, such as immediate containment or physical removal of oil, are important defenses.

Oil that came ashore during the 2010 spill triggered a bloom of bacteria that quickly consumed much of the oil compounds on Florida beaches. A large increase in the numbers of bacteria was observed in parallel with the consumption of oxygen and the majority of highly degradable oil hydrocarbons during the first four months after oil came ashore. The application of cutting-edge gene sequencing techniques by scientists studying the spill revealed a dramatic impact of oil on microbial diversity and the types of microbes present in beach sands after oiling. A time series of genetic data revealed that the types of microbes present changed in parallel with changes to the oil compounds present -- certain microbes eat certain compounds. A little over a year after the spill, microbial communities returned to close to their original condition and little to no oil could be detected.



Pictured to the Right: Oil-contaminated beach sand from Pensacola Beach; A clear layer of oil-stained sand (several centimeters thick) was present well below the surface. (Photo credit: Markus Huettel, Florida State University)

Deep-C Scientist Profiles: Dr. Joel Kostka & Dr. Markus Huettel

Dr. Joel Kostka is a professor of microbial ecology at the Georgia Institute of Technology. Kostka's research addresses the ecosystem services provided by microbes that aid our society, especially in the areas of water quality and nutrient cycling. Kostka investigates how quickly oil from the Deepwater Horizon discharge was degraded by natural microbial communities from shallow beach sands to the deepsea. In 2011, Dr. Kostka coauthored a report from the American Academy of Microbiology entitled, "Microbes and Oil Spills: Frequently Asked Questions."

Dr. Markus Huettel is a professor of oceanography at Florida State University. Huettel is a benthic ecologist researching how much and what oil components were transported into Gulf beach sands during the spill, how deep these oil components penetrate, and how rapidly they are degraded. Huettel investigated how dispersants, oxygen supply and the warm temperatures in the Gulf affected oil burial and decomposition. Zuijdgeest A, Huettel M (2012) Dispersants as Used in Response to the MC252-Spill Lead to Higher Mobility of Polycyclic Aromatic Hydrocarbons in Oil-Contaminated Gulf of Mexico Sand. PLoS ONE 7(11): e50549.

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