

What is Bioremediation?

Bio means “life”. **Bioremediation** uses living things to break down or remove toxins and harmful substances from soil and water. In particular, “**Bioremediation**” is often used to mean using beneficial bacteria and microorganisms, **phytoremediation** uses plants, and **mycoremediation** uses fungi and mushrooms.

Bioremediation looks at the whole system, the living soil communities, and aims to restore the maximum health, diversity, and life.

Some Methods

Bioremediation:

Compost teas and inoculants may be **aerobic**—full of air and oxygen, or **anaerobic**, low in oxygen. Generally, beneficial bacteria are oxygen lovers. But some beneficials, known as **Effective Microorganisms** or **EM** breed in anaerobic conditions. EM can be purchased or cultured, and can be used in mold abatement, against pathogens, as a general disinfectant, and for improving soil health.

Compost improves soil health and pH, adds organic matter and beneficial microorganisms. It helps soils hold water, provides plants with food at a slow and steady rate, and offers lots of surface area where toxic substances can be held for living organisms to break down or bind and make inert.

Worm Compost and **worm castings** increase beneficial soil bacteria that breed in worm guts. It adds valuable nutrients to improve soil health. They are an invaluable source of beneficial bacteria.

Aerated Compost Tea is specially brewed from compost, worm castings, molasses (to feed the beneficial bacteria) and other helpful nutrients to favor beneficial microorganisms. It is generally bubbled for 24-36 hours, at temperatures of between 65-85 degrees F and used immediately while populations of beneficials are at their maximum.

Mulch adds organic material to the soil, improves soil health and structure, and serves as a **substrate**, a habitat for worms, fungi, and soil bacteria.

Phytoremediation:

Plants are grown that can take up toxic substances, in particular, heavy metals. Specific plants accumulate different substances. When harvested, plant materials need to be treated as toxic wastes and cannot be eaten.

Some plants also generate an environment around their roots that favors beneficial bacteria that can break down some toxins in place.

Mycoremediation:

A mushroom is only a **fruiting body**, the visible reproductive organism of a larger body of **mycellium**, an underground web of threads or **hyphae** that are the main body of the organism.

Mushroom mycelium release enzymes that can break the chemical bonds of many petrochemicals and toxins. Some mushrooms can also uptake heavy metals—they must then be harvested and treated as toxic waste. Different species work best for specific toxins.

A **substrate**, often wood chips, sterilized straw or cardboard, is inoculated with mushroom **spawn** of a beneficial species. Inoculated substrate can also be used as a filter for flowing water. Some species of fungi will attack pathogens and bacteria.

Mycorrhizal fungi live in association with plant roots. Their threads interpenetrate the roots, helping them take in more nutrients and water. They can improve soil and plant health, and protect against toxicity and disease.

Complex strategies:

Polluted environments often contain many different sorts of toxic substances. Plants, mushrooms, and microorganisms can be combined in many different ways to regenerate healthy, thriving life in our soils and water.

What's in the Soil—and What to Do About It

Heavy Metals:

There are two basic classes of heavy metals: **cationic metals** and **anionic metals**:

Anionic metals:

(Anionic metals like to receive electrons in chemical reactions.)

Arsenic, Chromium

How'd they get into our environment?

Arsenic: from pesticides, herbicides, food, wood treatment

Chromium: from steel, leather and textile industries, electroplating

Possible Health Effects:

Arsenic: stomach and blood disorders, skin changes, lung irritation, carcinogen, infertility, miscarriages, heart and brain disorders

Chromium: (an essential micronutrient, but in overdose, skin rashes, nose irritations, ulcers, kidney and liver damage, lung cancer, respiratory illness)

Principles:

Elemental substances, they will not degrade.

Easily taken up by plants and living things

Less mobile in low pH (acidic) conditions

Aerobic conditions reduce mobility AND toxicity

More bioavailable with humic, fulvic, and citric acids

Tend to be sequestered in roots, not leaves (turnips and radishes)

Strategies:

Cover with vegetation

Immobilize:

- Don't add phosphorus

- Reduce pH—make soil more acid

- Foster aerobic conditions

- Nurture pseudomonas bacteria and other beneficial bacteria

Phytoremediation:

Arsenic: Brakefern (*Pteris vittata*), Indian mustard, (*Brassica juncea*)

Chromium: Indian Mustard, Creosote bush, (*Larrea divaricata* or *tridentata*)

Mycoremediation:

Arsenic: Matsutake mushrooms, (*Tricholoma magnivelare*) and

Shaggy mane mushrooms (*Coprinus comatus*)

When harvested, plant material and mushrooms must be bagged and thrown in garbage or treated as toxic waste

What's in the Soil—and What to Do About It

Heavy Metals:

There are two basic classes of heavy metals: **cationic metals** and **anionic metals**:

Cationic Metals:

(these like to donate electrons in chemical reactions)

Antimony, barium, cadmium, copper, lead, mercury, thallium, zinc,

How'd they get into our environment?

From:

Lead: from old paint, auto exhausts (less prevalent),

Cadmium: from old tires, manufacturing processes

Others: from wood treatment, manufacturing and refining processes

Principles:

Elemental substances, they will not degrade

Bond to soil, less likely to be taken in by plants, life forms

More soluble at low pH (acidic) conditions

Possible Health effects:

Damage to liver, kidneys, digestive system and nervous system disorders, reproductive disorders, bone damage, heart damage, immune system disorders, birth defects

Strategies:

Cover soil and vegetate

Immobilize:

- Raise soil pH by adding lime or compost

- Add organic material

- Phosphorus inhibits lead uptake

- Aerate/ raise beds

- Mycorrhizal fungi help prevent uptake

Phytoremediate (uptake in plants and remove):

- Plants: Indian mustard, alpine pennycress, sunflowers, dogbane, arapidopsis, carrots, corn, tobacco, barley, lettuce

- For lead, add chelation, EDTA, after plants are well grown, then harvest within a week

- Bag harvested plants and dispose in garbage or treat as toxic waste

What's in the Soil—and What to Do About It

Fuels and oil:

Diesel Fuel, gasoline, motor oil, crude oil
2,4 Dinitrotoluene and 2,6 Dinitrotoluene

How'd They Get Into Our Environment?

Fuels from: Refineries, gas stations, engines, pipelines
Dinos from: explosives

Potential Health Effects:

Carcinogens, reproductive disorders, cardiovascular and blood disorders, liver damage, nerve damage

Principles:

Bacteria and fungi use these chemicals as food, can break molecular bonds, yielding carbon dioxide and water

Methods:

Inoculate soil with beneficial bacteria, aerobic microorganisms, using aerobic compost tea, keep soil aerated, moist but not waterlogged

Build soil health, neutral pH, high in nutrients and microorganisms, low salinity

Windrow composting—keeping the process aerobic

Oyster mushrooms will break these down effectively, mulch with inoculated material

What's in the Soil—and What to Do About It

Polycyclic Aromatic Hydrocarbons

Benzo (a)pyrene, benzo (k) fluoranthene, benzo(a)anthracene, benzo(b) fluoranthene, Dibenzo [a,h] anthracene, Indeno[1.2.3-cd]pyrene

How'd They Get Into Our Environment?

From: combustion by-products, from grilled food, they bio-accumulate in seafood, fish

Principles:

Degraded by bacteria and fungi

Slow to degrade

Cling to sediment and soils

Stay near surface

Unlikely to move into vegetables or crops

Strategies:

Mulch with material inoculated with white rot fungi, especially

Oyster mushrooms (*Pleurotus ostreatus*).

Inoculate with aerated compost tea

Establish aerobic soil conditions

Organo Chlorines/Pesticides

Dieldrin, Heptachlor, Heptachlor Epoxide, Notrogezene

How'd They Get Into Our Environment?

From pesticides, termite control

Possible Health Effects:

Carcinogens, disorders of blood, cardiovascular system, kidneys, neurological system, reproductive system, respiratory system, skin, sense organs

Principles:

Ultimately susceptible to microbial action

Very persistent/slow and difficult to degrade

May require anaerobic conditions, followed by aerobic conditions

Strategies:

Natural bacteria and fungi will attack

Mulch with material inoculated with white rot fungi, spray with EM (effective micro-organisms,

Follow by establishing aerobic soil, inoculating with aerated compost tea

Common Ground Biobrew

“Bioremediation” means cleaning soil and water using nature’s own cleaners: plants, bacteria and fungi.

Healthy soil is full of beneficial bacteria: as many as 600,000,000 in a single teaspoon! These little critters gobble up disease-causing bacteria and break down chemicals and toxins. They will make your yard a healthier and more fertile place.

Our biobrew will help restore the beneficial bacteria to your soil. We make it from natural, completely safe materials. Special compost worms carry beneficial bacteria in their gut. Their castings are a rich source. We brew a ‘tea’ of worm castings, sugar to feed the bacteria, organic supplements, and keep it bubbling with air for 24-36 hours. Beneficial bacteria love air, and this process creates ideal conditions for them to grow.

Biobrew is best applied immediately after the air is turned off, when the most number of air-loving bacteria will be alive and thriving. After four hours, the beneficial bacteria may start to die.

Common ground volunteers are delighted to apply biobrew to your yard. Thank you for helping us to heal the soil of New Orleans.

For more information, contact 504-913-5635



Compost Bin

Place food scraps here and cover with dry material. Please replace cover.

How compost works:

A working compost pile is a happy home for beneficial bacteria and other beasties that will munch your food wastes and turn them into fertilizer for the garden.

Recipe for compost:

One part wet, green stuff high in NITROGEN: food scraps, manure, green grass clippings or garden prunings.

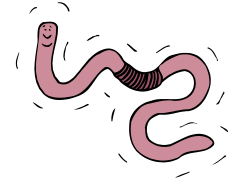
One part dry, brown stuff high in CARBON: straw, wood chips, dry leaves, paper, sawdust, etc.

Build a pile or fill a bin in layers about 3-10 inches thick. Ideally, the pile should be at least 3 feet square and 3 feet high.

Add air and keep moist as a damp sponge.

Stand back and let it rot! (You can speed up the process by turning the pile, but that's more work!)

Raising compost worms:



The worms in your bin, red wigglers, eat compost, leaf litter and decaying organic matter. They like shredded newspaper for bedding, and a folded section on top so they can crawl between the sheets and do just what you like to do between the sheets, breeding more worms for your colony.

Let them settle into their new home for a week or two, feeding them minimally. After that, you can add food scraps. Watch how they disappear, and when they are nearly gone, add more. If you add too many, some may rot or ferment or grow mold—which may or may not hurt the worms but can look rather disgusting.

Worms need air. Punch holes in the bottom and sides of a five gallon bucket or a plastic container, keep it lightly covered so rain doesn't drown them, and keep them in the shade or in a cool basement or garage. Worms should be kept damp as a wring-out sponge. They like the same range of temperatures that we enjoy. They love the darkness, hate light.

Feed them vegetable scraps, coffee grounds, tea leaves, paper napkins, weeds, etc. They are not wildly fond of citrus peels. A thriving colony can handle some amount of cooked food scraps, but a new colony may not be able to process them before they mold or attract other vermin. Keep meat scraps out, as they may smell bad.

Harvest worm castings to fertilize your garden or dissolve them in water to make worm tea (for your plants, not for you!) It's great fertilizer for plants in your garden, houseplants and potted plants.

