# UNIT 3 BIOTECHNOLOGY FOR THE ENVIRONMENT

## A. ENVIRONMENTAL BIOTECHNOLOGY

### NATURE HELPS US TO CLEAN AIR, SOIL, WATER AND … DO THE LAUNDRY

Environmental biotechnology is a field with great potential. Biotechnologists are increasingly learning how to apply the knowledge about biological metabolic processes in the field of environmental protection, including waste management and environmental rehabilitation.
There are many examples of areas where environmental biotechnology can be applied.
Wastewater treatment plants are nothing without bacteria. These invisible organisms put their metabolism to good use in the purification of polluted wastewater.
Biotechnology has also proven useful for the remediation of contaminated soils. For example an *in situ* technology has been developed where naturally occurring soil microorganisms can be activated to degrade mixtures of toxic substances.
Biosensors used for the detection of harmful substances in water, air and soil are the key tools of environmental biotechnology. Researchers are developing systems based on microorganisms or enzymes that can help indicate environmental toxins.
Novel, precise and inexpensive methods are being developed to monitor air contamination, especially by heavy metals.
Saving raw materials and resources is another form of environmental protection. The importance of biotechnology in the area of renewable fuels will increase significantly over the next few years, for example with regard to the production of bulk chemicals, which up until now have been produced using petrochemical manufacturing methods.
The production of bio surfactants used in washing agents and soap is another area where biotechnological methods are used. The application of enzymes isolated from extremophilic microorganisms might also lead to a reduction in energy consumed. Washing agents containing such enzymes can be used at lower temperatures and help save electricity.

**1** *Choose the correct meaning of these words underlined in* Nature helps us to clean air, soil, water and… do the laundry.

**a.** *field*

**1.** area of land; **2.** range of interest and action

**b.** *management*

**1.** board of directors; **2.** organization and control

**c.** *rehabilitation*

**1.** medical treatment to restore health; **2.** restoration of the previous conditions

**d.** *areas*

**1.** extent of surfaces; **2.** ranges of activity

**e.** *purification*

**1.** removal of harmful substances; **2.** removal of dirt

**f.** *remediation*
**1.** cleaning up of a contaminated area; **2.** correction of an error

**g.** *detection*
**1.** discovery of the presence; **2.** investigation of a crime

**h.** *key tools*
**1.** tools to lock and unlock doors; **2.** very important tools

**i.** *monitor*
**1.** make continuous observations; **2.** view on the computer screen

**j.** *heavy metals*
**1.** metals of great weight; **2.** pollutant metals

**k.** *raw materials*
**1.** uncooked materials; **2.** unprocessed materials

**l.** *bulk chemicals*
**1.** chemicals produced in large quantities; **2.** very large chemicals

**m.** *washing agents*
**1.** people helping with the washing; **2.** substances used to do the washing

**n.** *extremophilic microorganisms*
**1.** extremely active microorganisms; **2.** microorganisms active at extreme temperatures

## 2 *Answer these questions about* Nature helps us to clean air, soil, water and … do the laundry.

**a.** What microorganisms are used to purify polluted wastewater?
**b.** How can soil microorganisms be used in soil remediation?
**c.** What are biosensors used for?
**d.** How can environmental toxins be detected?
**e.** How can enzymes in washing agents help save electricity?

# B. BIOREMEDIATION

## THE USE OF MICROORGANISMS IN BIOREMEDIATION

Microorganisms need to take in nutrients from their environment to grow and divide. The microbes metabolize these nutrients, which means that the substances the microbe takes in are broken up and the microbe excretes different substances. In bioremediation, the substances they excrete are less harmful than the original pollutant. Basically, the microbes eat the pollution and clean up the area.

Microorganisms perform bioremediation in one of three ways. Sometimes the microbes in a polluted area adapt to the pollution naturally and break it down as part of their food source or adapt to the toxins enough to survive and convert the pollution into substances that are harmless to the microbes and to other forms of life. This natural system is called natural attenuation. If the microbes will not break down the pollutant naturally, addition of nutrients may stimulate bioremediation. This process is bio-stimulation. Lastly, humans can artificially add a new microbial population to an area to deal with the pollutant. This is known as bio-augmentation. Some microbes can break down petroleum products and the by-products of petroleum that are carcinogenic. This can work for groundwater contamination or marine oil spills. Bacteria can also remove heavy metals from the environment such as mercury. Other bacteria can break down solvents and chlorinated substances. Certain pesticides are also edible to bioremediation microbes. Although some species of microbes naturally have the capability to break down pollutants, some other microbes for bioremediation use are genetically modified to artificially give the microbe those abilities.

Microorganisms are relatively cheap to produce and use compared with other pollution control measures. Landfill is reduced as the contaminated soil does not need to be removed and no materials are used to soak or collect the pollutant. The microbes self-replicate, and their use tends to be more environmentally-friendly with fewer side effects than other control methods.

Microorganisms in bioremediation may take several years to completely clean the polluted area. Even after the clean-up is complete, the microorganisms themselves may need to be harvested to remove pollutants such as stored uranium. Climate can also play a role in the efficiency of the process, as the applied microbes may be washed away or killed through drought.

**3** *Number these topics in the order they are dealt with in* The use of microorganisms in bioremediation.

- ☐ Advantages of bioremediation
- ☐ Artificial design of microorganisms
- ☐ Disadvantages of bioremediation
- ☐ Types of bioremediation
- ☐ Types of pollution

**4** *Decide which of these verbs – taken from* The use of microorganisms in bioremediation – *are synonyms of the following phrasal verbs:* absorb, purify, remove by water, separate, treat.
*Tip: copy the pairs in your indexed book.*

**a.** take in: .....
**b.** break up/down: .....
**c.** clean up: .....
**d.** deal with: .....
**e.** wash away: .....

**5** *Decide which of these adjectives – taken from* The use of microorganisms in bioremediation – *are antonyms of the following ones:* expensive, few, friendly, more, partial, poisonous, same. *Tip: copy the pairs in your indexed book.*

**a.** different: .....
**b.** harmless: .....
**c.** natural: .....
**d.** edible: .....
**e.** cheap: .....
**f.** fewer: .....
**g.** several: .....
**h.** complete: .....

**6** *Which of the words underlined in* The use of microorganisms in bioremediation *match the definitions below? Tip: copy the definitions in your indexed book.*

**a.** accidental releases of petroleum into a water body: .....
**b.** addition of nutrients to stimulate bioremediation: .....
**c.** all the surroundings of a living organism: .....
**d.** damaging moisture shortage: .....
**e.** disposal of waste buried under the ground: .....
**f.** food substances providing energy and building material: .....
**g.** harmless for the environment: .....
**h.** having an altered genetic make-up: .....
**i.** microbial population added artificially to an area to deal with pollutants: .....
**j.** poisonous metals with a high specific gravity: .....
**k.** poisonous substances produced by the metabolic activity of living organisms: .....
**l.** secondary or incidental product: .....
**m.** secondary usually undesirable outcomes: .....
**n.** substances that can be dissolved in or dissolve other substances: .....
**o.** substances used to kill pests: .....
**p.** the contamination of the environment by harmful substances: .....
**q.** very tiny one-celled organisms: .....
**r.** water beneath the earth's surface: .....