ENVIRONMENTAL BIOTECHNOLOGY

broad: *wide*
detection: *discovery, finding*
to exhaust: *to consume, to finish*
labelled: *identified, marked*
restauration: *repair*
tailor-made: *made to meet specific needs*

B.t.

Bacillus thuringiensis was named after the German region Thuringia where it was discovered (early 1900s) to be able to kill a flour moth. Farmers started to use *B.t.* as a pesticide in 1920 but it was not used widely since synthetic insecticides were readily available and often very efficient in killing insects. In 1956, research on *B.t.* started again with more effort. In the 1980's, use of *B.t.* increased when insects became increasingly resistant to synthetic insecticides and scientists and environmentalists became aware that the chemicals were harming the environment, whereas *B.t.* is organic and does not persist in the environment. Today, there are thousands of strains of B.t.; many of them have genes that encode unique toxic crystals in their DNA. With the advancement in molecular biology, it is possible to move the gene that encodes the toxic crystals into a plant. The first genetically engineered plant, corn, was registered with the EPA in 1995. Today, GM (genetically modified) crops including potato and cotton are planted throughout the world.

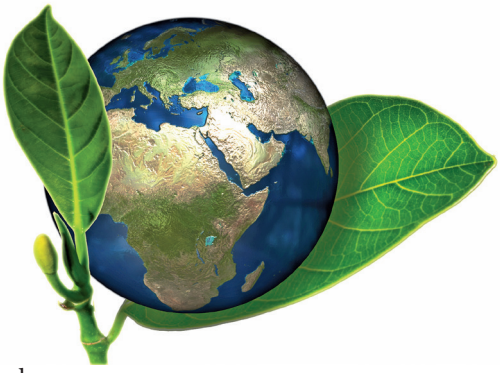
1 **Which of these biotechnology products or processes do you consider most helpful to the environment? Number your priorities and then discuss them as a class.**

- ☐ Prevention of environmental pollution
- ☐ Monitoring of the quality of the environment
- ☐ Clean-up of contaminated environments using biological processes
- ☐ Development of bacterial methods for treating waste
- ☐ Improvement of soil quality
- ☐ Creation of improved agricultural plants and domestic animals
- ☐ Creation of plants which protect themselves against harmful insects
- ☐ Creation of alternative renewable bioenergy
- ☐ Development of processes that use less non-renewable resources and energy
- ☐ Development of products and processes that generate less waste
- ☐ Creation of biodegradable and low toxicity products
- ☐ Production of new biomaterials
- ☐ Other .....

ACTIVITIES

Environmental Biotechnology utilises the biochemical potential of microorganisms and plants for the preservation and restoration of the environment. It includes a broad range of applications such as prevention, detection and monitoring of pollution; bioremediation of land, water and soil; sustainable development with promotion of green manufacturing techniques and efficient use of natural resources in industrial processes; reduction of waste generation and waste treatment; genetic engineering.
Biological detection methods use biosensors and immunoassays. Biosensors are analytical devices that convert biological responses into physical, chemical or electrical signals. It is then possible to make quantitative measurements of pollutants with extreme precision. Immunoassays use labelled antibodies and enzymes to measure pollutant levels. If a pollutant is present, the antibody attaches itself to it making it detectable either through colour change, fluorescence or radioactivity.
Biotechnology techniques are being applied to produce plant varieties resistant to insects and diseases, which may considerably reduce the use of pesticides. Several examples of such plants involve the use of organisms genetically modified by recombinant DNA technology. Natural bio-pesticides degrade rapidly, leave no residues and are toxic

only to target insects. *Bacillus thuringiensis* (*B.t.*) produces a protein that is naturally toxic to certain insects. Scientists have extracted the *B.t.* gene that expresses the insecticide and inserted it into common bacteria that can be grown in large quantities by fermentation techniques. Spread on crops, these harmless bacteria control insects naturally. Moreover, a wide range of crop plants has been genetically engineered to express the insecticidal genes (found in *B. t.*) in their tissues, so the insects are killed as they feed on these crops.



Many enzymes are routinely produced by genetically modified organisms too. Many industrial processes have been made more environmentally friendly by the use of enzymes, which are non-toxic and biodegradable and have numerous advantages over non-biological catalysts. Production methods that employ enzymes are generally not only cleaner and safer compared with other methods, but are also more economic in energy and resource consumption.

The application of DNA technology in the different kinds of biotechnology offers the possibility of creating new gene combinations that have not previously existed in nature. Since its beginnings, genetic engineering has claimed to be able to construct tailor-made microorganisms with improved degrading capabilities for toxic substances as well as to create environmentally friendlier alternatives for products and processes that presently pollute the environment or exhaust its non-renewable resources.

2 Take turns in asking and answering these questions about the reading passage.

1. Which tools does Biotechnology employ to preserve and restore the environment?
2. What are the main applications of environmental biotechnology?
3. How do biosensors work?
4. How do immunoassays detect pollutants?
5. What are some examples of the applications of biotechnology in agriculture?
6. What are the advantages of bio-pesticides?
7. What is the most successful bio-pesticide and how does it work?
8. How have scientists worked with B.t.?
9. What are the advantages of enzymes over non-biological catalysts?
10. How can genetic engineering help the environment?

3 Find words to match these definitions.

1. A single unit of genetic information: _ _ _ E
2. An extremely small living thing that can only be seen with a microscope: _ _ _ _ O O _ _ _ _ _ _ _ _
3. A protein produced in the blood in response to a specific agent: _ _ _ I _ _ _ Y
4. A natural protein in plants and animals which speeds up biochemical reactions: _ _ _ Y _ _
5. The manipulation of the genes in an organism, with the intent of improving it: _ E _ E _ _ _ E _ _ _ _ E E _ _ _ _
6. The total surroundings of living organisms: E _ _ _ _ _ _ _ E _ _
7. The presence in the environment of substances harmful or poisonous to living things: _ O _ _ _ _ _ O _
8. An organism whose genetic material has been altered using genetic engineering: _ _ O
9. A pesticide consisting of naturally occurring or genetically engineered microorganisms: _ I _ - _ _ _ _ I _ I _ _
10. Techniques for separating and recombining segments of DNA or genes: _ E _ _ _ _ _ _ _ _ _ _ _ A _ _ _ _ _ O _ O _ _

ACTIVITIES