

BIOREMEDIATION

Work in pairs. Ask and answer questions about science and technology.¹

1. What was your favourite science subject? Biology? Physics? Chemistry? Why?
2. What is the difference between science and technology?
3. In your opinion, what is the greatest technological invention?
4. Do you think couples should be allowed to choose the sex or other characteristics of their baby like eye colour? Why or why not?
5. Have you heard of biotechnology? Can you define it?
6. Place the examples of biotechnology into the right column.
Do you know any other examples?

making cheese/yogurt	antibiotics	vaccines
cloning	making wine/beer	biodegradable plastics
anthrax	biofuels	genetically modified plants
		ricin

Food	Medicines	Eco-friendly products	Waste Disposal	Genetics	Biological Weapons

Academic vocabulary

Read the explanation of bioremediation. The following words will fill the gaps:

compounds environment involve involving process processes
remove role source specific

Bioremediation is a process ¹ _____ living microorganisms used to break down harmful chemical ² _____ of contaminated soil or water in an ³ _____. Bioremediation can take place under aerobic or anaerobic conditions. Many microorganisms can survive with or without a ⁴ _____ of oxygen. In aerobic conditions, the microorganism can use oxygen from the atmosphere. In anaerobic conditions, the breakdown of soils occurs for a source of oxygen and the metals can play the ⁵ _____ of oxygen. There are three types that ⁶ _____ different ⁷ _____ such as biostimulation, bioaugmentation and intrinsic bioremediation. Biostimulation is the use of nutrients and oxygen (liquid or gas form) added to stimulate already existing bacteria. Bioaugmentation is when microorganisms are added to the contamination that target ⁸ _____ contaminants and intrinsic bioremediation takes place underground and is the use of the microorganisms to ⁹ _____ harmful substances from soil and water. Bioremediation is safe and does not cause a threat to the health of society because the microbes form in the soil and it is a natural ¹⁰ _____ .

LISTENING: BAV 1²

Atlanta (Jan. 20, 2004) — Investigators lead by Professor Frank Löffler in Georgia Tech's School of Civil and Environmental Engineering have isolated a bacterium they named BAV-1 that can be used to clean toxic sites and prevent cancer-causing substances from reaching drinking water supplies.

Kirsti Ritalahti is reporting on the findings.

1. Listen and circle the right answer:

The bacterium lives in: a) soil
 b) groundwaters
 c) the sea

2. Listen again and fill in the gaps according to the recording.

They're very good organisms. These organisms help a lot of the contaminated areas, or sites that we would have around in our environment and they do so by just carrying out their daily activities. So they're and eating various chemicals that are in the and they survive that way and at the same time they help us by things that we don't want to have there.

We have recently an organism that we refer to as BAV 1, and that stands for Bachman vinylchloride 1. Bachman is the road site where we found it and it degrades this chemical vinylchloride that contains one chlorine on it and it's a and a chemical we don't want accumulating in our groundwater supplies at all. And BAV 1 is a member of a group of organisms called Dehalococcoides, and that's basically, „dehalo-„ means removing a, like chlorine, and „coccoide“ means a shape. This is Dehalococcoides isolate BAV1. It's very small, it's smaller than one micron in, and it lives in our groundwaters – in almost any groundwater area. It does not grow using – in fact, if we put it out in our room, it would die. It has to breathe these chlorinated

READING³

1. Matching words and definitions:

municipality	an attraction or force between particles that causes them to combine
improper	to find a profitable or practical use for
disposal	of high price or value; expensive
render	a city, town, or other district with its own local government
costly	to cause to become; to make
utilize	not correct, unsuitable for the purpose or occasion
affinity	the act of getting rid of something, a means of destroying waste products

2. Read the title and the introduction of the following piece of news.

Nature's Helpers: Using Microorganisms To Remove TCE Pollutants From Water

Mar. 1, 2008 — In 2002, Bruce Rittmann, PhD, director of the Biodesign Institute's Center for Environmental Biotechnology, received a patent for an innovative way to use nature to lend society a hand. He invented a treatment system, called the membrane biofilm reactor (MBfR), which uses naturally occurring microorganisms to remove contaminants from water.

3. Before reading further, put the main ideas of individual parts of the text (paragraphs) in the order as you would expect them in the article.

- A *explaining what organisms are utilized in this technology*
- B *summarizing the significance of the discovery*
- C *introducing the method of eliminating harmful effects*
- D *informing about the technology and its character*
- E *describing how the system works*
- F *describing the source and the effects of the contaminant*

4. Read the article and identify the beginnings and ends of paragraphs.

Now Rittmann and his research team recently published a paper in the journal *Environmental Science & Technology* for a new application that removes a contaminant that has made local headlines. The chlorinated solvent trichloroethene (TCE) has been found to be an increasingly problematic contaminant in groundwater. The detection of TCE recently forced the shutdown of the water supply for the municipalities of Paradise Valley and Scottsdale. TCE has been widely used as a cleaning agent and solvent for many military, commercial, and industrial applications. Its widespread use, along with its improper handling, storage, and disposal, has resulted in frequent detection of TCE in the groundwater. TCE has the potential to cause liver damage, malfunctions in the central nervous system and it is considered a likely human carcinogen. Transforming the chlorinated solvent to a harmless product is the best way to eliminate the harmful effects of TCE. In the case of TCE, Mother Nature is the best helper. Scientists have discovered specialized microorganisms that can replace the chlorine in the chlorinated molecules with hydrogen, a process called reductive dechlorination. While other methods are possible, they are often more costly than reductive dechlorination on a large scale, and many do not transform TCE into a harmless end product. In the paper, the Rittmann team utilized the MBfR and a naturally occurring group of microorganisms able to remove TCE from water. Surprisingly, these microorganisms, called dehalogenators, have an affinity for chlorinated organics and can be found all throughout nature, even in clean water supplies, the soil, and groundwater. "These bacteria respire TCE, that is, they can use TCE like we use oxygen to breathe," said Krajmalnik-Brown, a member of the team. "They take in the TCE and they start removing the chlorines, step by step. In the ideal case, the dehalogenators remove all the chlorines, converting TCE to ethene, which is harmless." Rittmann's MBfR works by delivering hydrogen gas to the bacteria through tiny hollow tubes submerged in water. In the right environment, the tubes become coated with a biofilm containing microorganisms. The system provides the microorganisms with hydrogen gas, which must be present for the microorganisms to change the chemical composition of a contaminant and render it harmless. By assessing the MBfR community, they found the special dehalogenating bacteria that can take the hydrogen supplied by the MBfR and reduce TCE all the way to harmless ethene. Using the latest molecular techniques, they could not

only identify the bacterial population to handle TCE, but also the genes within these populations that make enzymes that detoxify TCE to ethene.

5. Compare your order from exercise 3 with the order in the text.

Noun phrases

Noun phrases (adjective + noun, noun+ prepositional phrase) **are frequently used in academic texts to express a large amount of information. They help to summarize information and are often basic units of a text.**

Complete the adjective+noun phrases with words from the text.

..... team use dechlorination
..... application handling end product
..... solvent effects gas
..... contaminant microorganisms bacteria

Work in pairs and use the noun phrases to summarize the information from the article.

Writing (in groups of 4)

What are the advantages and disadvantages of bioremediation? Express your opinion.

- **brainstorm ideas in your group**
- **write your points**
- **make corrections, improvements**
- **present your writing in the class**

Grammar.⁴ Plural of Latin and Greek words in English.

In specialized terminology there are a lot of words of Latin and Greek origin. They usually form the plural by the same endings as in their original languages.

a) Study the chart and put the nouns into the appropriate columns

analysis [ɪs] analyses [ɪːz]	nucleus [əʃ] nuclei [aɪ]	formula [ə] formulae [iː]	datum [əɪm] data [ə]

series [ɪːz] series [ɪːz]	criterion [n] criteria [ə]	appendix [ɪks] appendices [ɪsiːz]	genus [s] genera [rə]

larva, medium, synthesis, coccus, phenomenon, alga, bacillus, thesis, fungus, crisis, vertebra, calyx, spirillum, species, mitochondrion, bacterium, cervix.

b) How do you pronounce: cocci, algae, fungi, calyces?

c) Change the following sentences from plural to singular.

Example: 1. These data suggest a change in volume. – This datum suggests a change in volume.

2. What criteria did the scientists use?
3. The formulae represent the molecular structures of the substances.
4. The investigated phenomena are not frequent.
5. The analyses of the results did not prove his hypotheses.

d) Write the plural form of the words in *italics*. Example: fungus - fungi

1. Even the best psychiatrists sometimes make mistakes in their *diagnosis* and treatment.
2. A scientist is supposed to generate *hypothesis* and test them against empirical observations.
3. Nuclear energy is produced using the heat generated by splitting the *nucleus* of atoms of certain elements.
4. After analysing all the *datum*, they were able to draw conclusions.
5. *Bacterium* are capable of bringing about chemical reactions of amazing variety.

Sources: ¹ Available at <http://iteslj.org/questions/>
² Available at <http://www.innovations.gatech.edu/bioremediation/avindex.php>
³ <http://www.sciencedaily.com/releases/2008/02/080228100728.htm>
⁴ Oreská, Alžbeta. *Activity book English for chemists*. Bratislava : Slovenská technická univerzita, 2005.