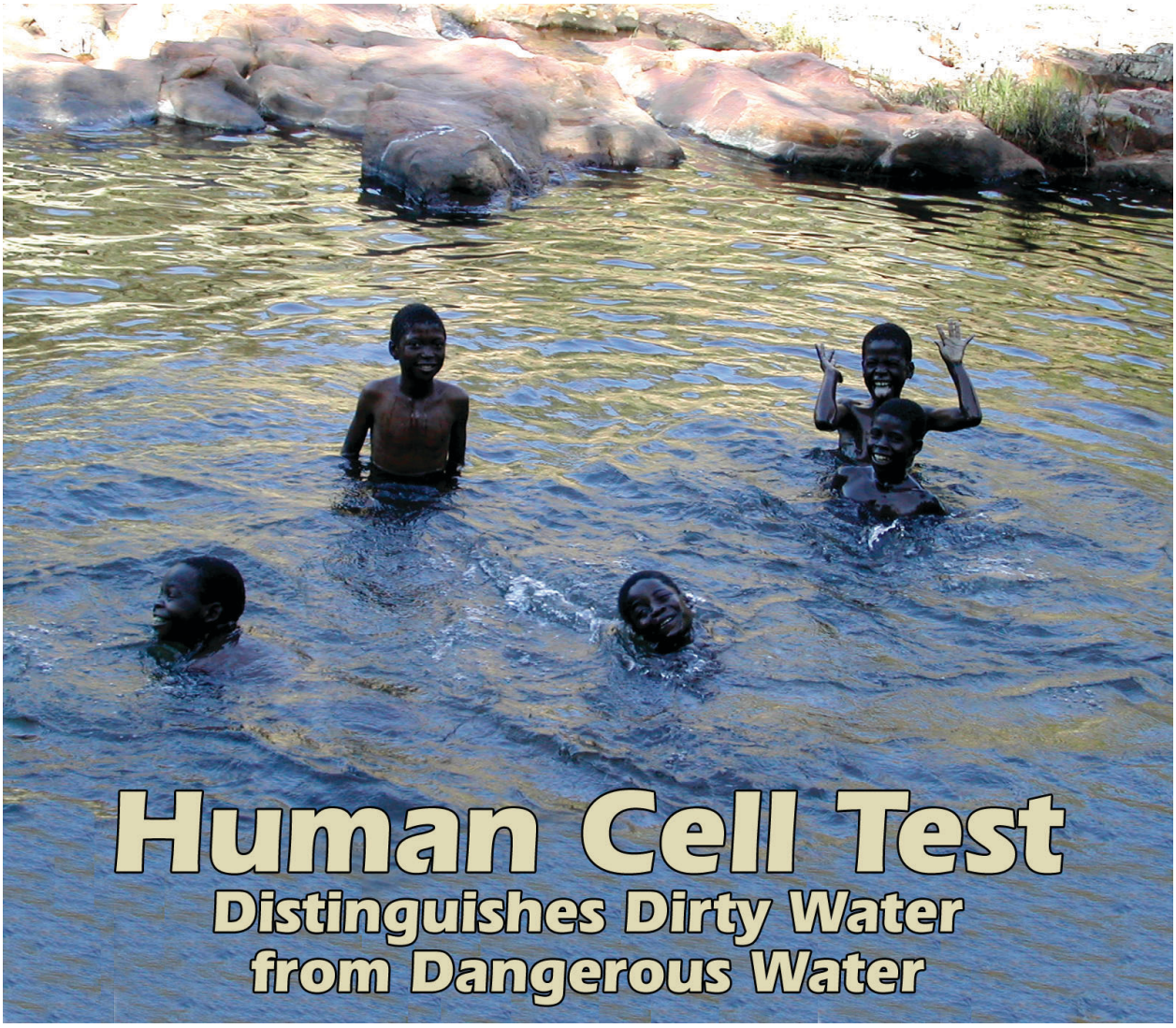


Human Cell Test
Distinguishes Dirty Water from Dangerous Water

The Human Cell Test (HCT), based on assays originally developed by the pharmaceutical industry to test the effect of drugs on the human body, is now being used in South Africa to test water for toxic substances.

Whereas other aquatic toxicity tests are aimed at finding pollutants that are harmful to the environment, the HCT targets toxic substances that could adversely affect human health.

How? "We look for a reaction when a water sample comes into contact with human leukocytic (white blood) cells. These cells are in contact with everything that goes into the body. Drinking water goes through the bloodstream so it would come into contact with these cells. If these cells cannot tolerate what is in the water, it is unlikely that a person would," explains Dr Mike Whitcutt, director of research for the Highveld Biological Association, a Section 21 company appointed by the Water Research Commission (WRC) to take the HCT from theory to practical application.

TOXICITY

Dr Whitcutt and his team have used the Human Cell Test in a pilot project on the East Rand, covering a large

Dr Mike Whitcutt, Director of Research for the Highveld Biological Association

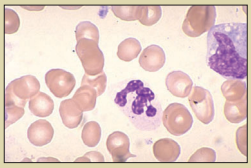
area from Soweto to Springs and down to Heidelberg and Vereeniging. They have identified two different types of toxicity in the water: one from very harmful substances, such as mercury or cyanide, and another from toxic overloads of substances, such as sulphates, which are tolerable in reasonable amounts but not in excess.

These toxic substances, says Dr Whitcutt, come from industry and homes in the area. "We have found that water coming through the taps is absolutely safe but the water that is released into the environment and seeps into the ground often contains dangerous agents, which could cause chronic illness." And there is no need for direct human contact as the contaminated water is sometimes used for irrigation and feeding of domestic animals.

Using the Human Cell Test, toxicity can be detected before it becomes a problem. When a pipe burst and wastewater flowed into environmental water sources on the East Rand last year, the Highveld Biological Association was called to do the HCT and discovered that the water in some recreational areas was completely toxic and unsafe. "Just a single HCT confirmed that there was a problem. The area was then mapped out and treated by the local authority. A month later, the water was safe again," says Dr Whitcutt.

COSTS

What's the cost? "It doesn't involve increased expenditure in terms of analysis, it is just more focused expenditure, which is ultimately profitable for everyone," continues Dr Whitcutt, pointing out that the HCT is particularly useful for checking water used for industrial purposes." An evaluation of the test would tell the organisation exactly what problematic substance it is discharging. Thereafter the offensive effluent could be monitored by simple chemical analysis."



Examples of leucocytes

HOW DOES THE HUMAN CELL TEST WORK?

- Water containing toxins is added to about 30 000 leukocytic (white blood) cells (stabilised K-562 cells).
- The water reacts with the cells for 18 hours during which it impairs the oxidative ability (central energy pathways) of the cells.
- After 18 hours, an indicator reagent (MTT) is added and left to react with the cells for three hours. Depending on the oxidative ability left in the cells, the MTT would change from yellow to blue.
- After three hours, a detergent is added to "freeze" the reaction.
- The colour of the solution is analysed spectrophotometrically to determine how far the colour reaction has progressed from yellow to blue.
- The results indicate the extent to which the oxidative ability of the cells was impaired – an indication of cytotoxicity.

The relatively low cost of the HCT allows concerned members of the public to take samples of the polluted water to a laboratory to determine the quality of drinking water

Annatjie Moolman, head of the WRC's Water and Health domain and research manager, says the research team has calculated the cost of the HCT at about R300 per sample (versus R1 800 per sample for a "full" probability test). The research team also finds that the turnaround time for the HCT is only two days. This makes it ideal as a screening test that could be used as a part of a suite of analyses in the identification of problems that need further investigation.

The relatively low cost of the HCT allows NGOs and concerned members of the public to take samples of the polluted water to a laboratory to determine the quality of drinking water. It could also be used by government, water utilities and catchment management agencies to test water over vast geographic areas. The authorities would then be able to quickly identify problem areas, allocate funds where they are most needed (for detailed analysis) and, ultimately, protect the health of the people who drink the water.