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Sorption Technologies & Molecular Solutions for (Bio)monitoring and Removal of Pollutants

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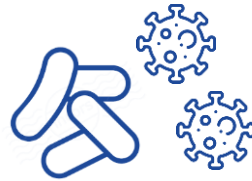
Why should we pay attention to micropollutants /emerging pollutants?



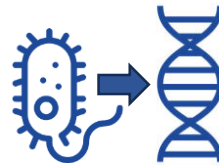
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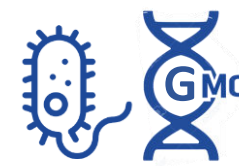
pharmaceuticals



*pathogens: bacteria,
viruses and fungi*



*free-floating, extracellular,
virulent DNA*



*genetically modified microorganisms,
genetically modified DNA*



pesticides

Why to take care:

- Microcontaminants are not removed to a sufficient extent in traditional wastewater treatment plants. They end up in groundwater, rivers, lakes, and seas.
- The rapid growth of the pharmaceutical industry and consumption is generating increasing amounts of microcontaminants.
- The threat of a new pandemic – silent pandemics with antibiotic-resistant bacteria

Novel bioinformatic tools for facilitating (bio)monitoring of antibiotic resistance genes in various environments



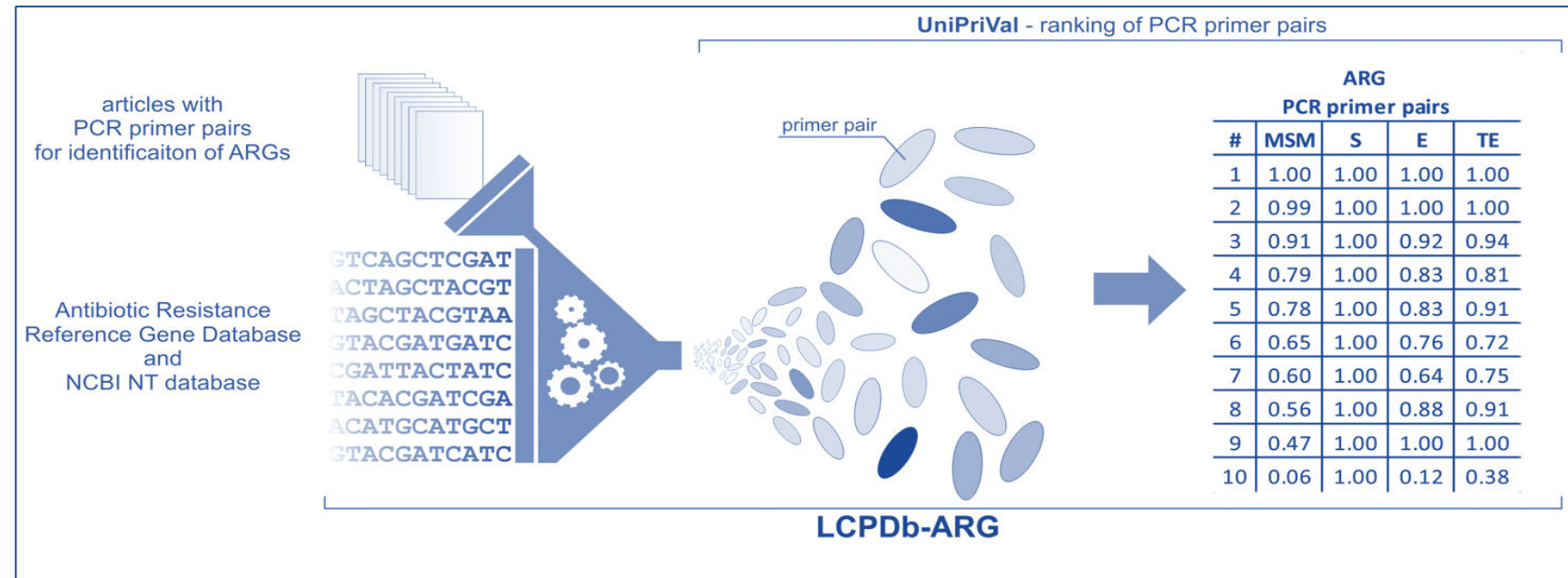
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Molecular-based diagnostic or monitoring systems are error-prone due to the lack of an efficient and cheap method for their validation and development.

Example of innovation:

Challenge: Development of bioinformatic tools for validating existing and future DNA-based diagnostic systems.

Result: The developed system generates rankings of available PCR-based methods for detecting antibiotic resistance genes.



Welcome to the LCPDb!

LCPDb gathers, verifies and compares properties of hundreds of primer pairs published over the years. At the moment, we present primer pairs dedicated to identification of antibiotic resistance genes (LCPDb-ARG) and genes involved in metal metabolism and resistance (LCPDb-MET).

How To Use

Browse LCPDb-ARG

Browse LCPDb-MET

<http://lcpdb.ddlemb.com/>

Novel molecular-based detection systems for tracking of pathogens and specific genes (e.g. antibiotic resistance genes)



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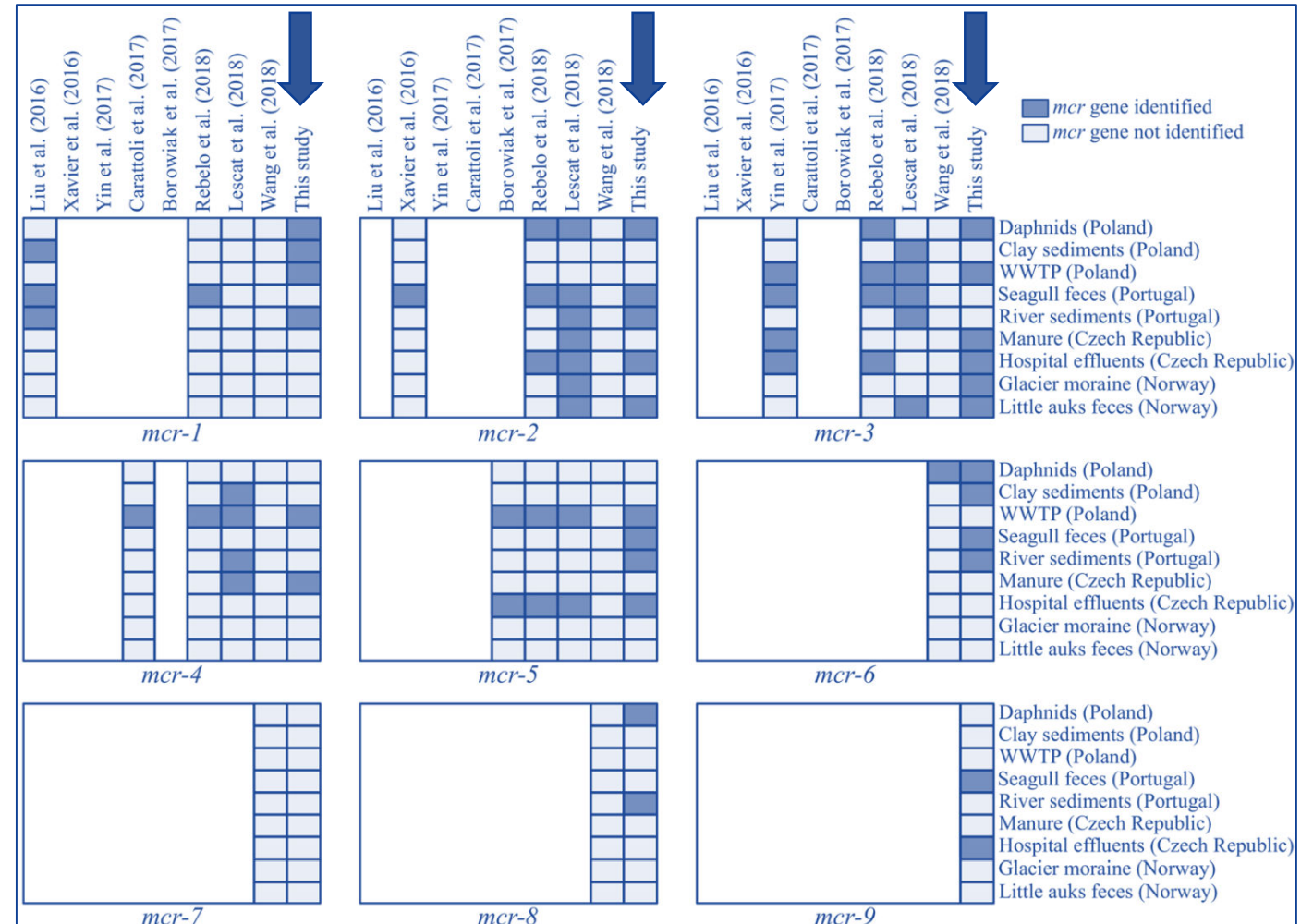
Antibiotics of the last resort – e.g. colistin.

The *mcr-1–mcr-9* genes confer resistance to colistin. The most clinically relevant is *mcr-1*.

Example of innovation:

Challenge: Development of novel primers for the quick detection of the colistin resistance genes in environmental samples.

Result: The developed (q)PCR-based system is more specific and accurate.



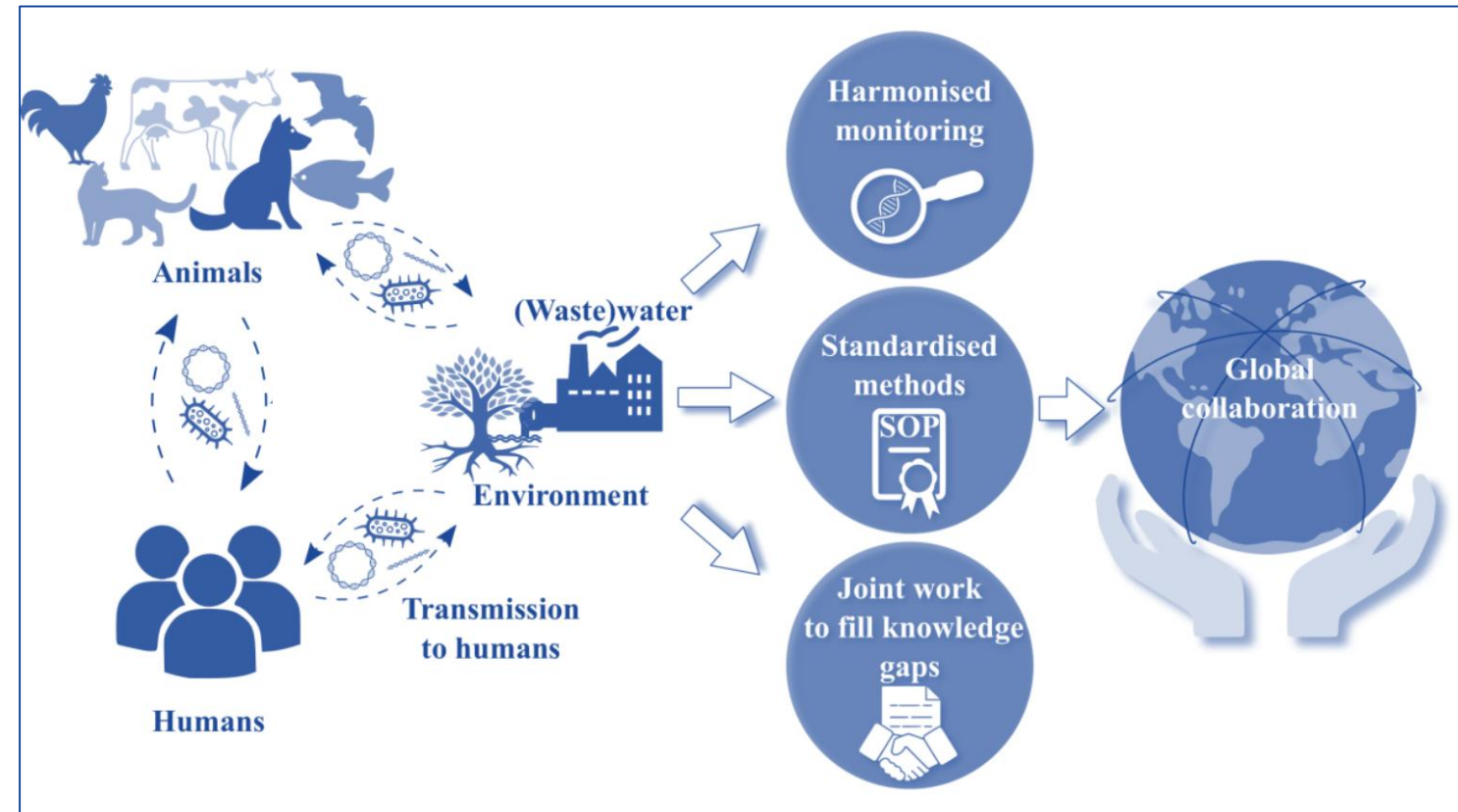
Where and how can we use developed molecular-based diagnostic tools?



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Example applications:

- New systems/kits for DNA-based monitoring of pathogens, virulence genes, and antibiotic resistance genes in the environment, veterinary medicine, and healthcare.
- New systems/kits for DNA-based monitoring of microbiological purity in industry (e.g., food production).
- Analytical/bioinformatics services providing verification of the effectiveness of DNA-based diagnostic tools.



Minerals for DNA adsorption – removal of free-floating DNA using mineral sorbents



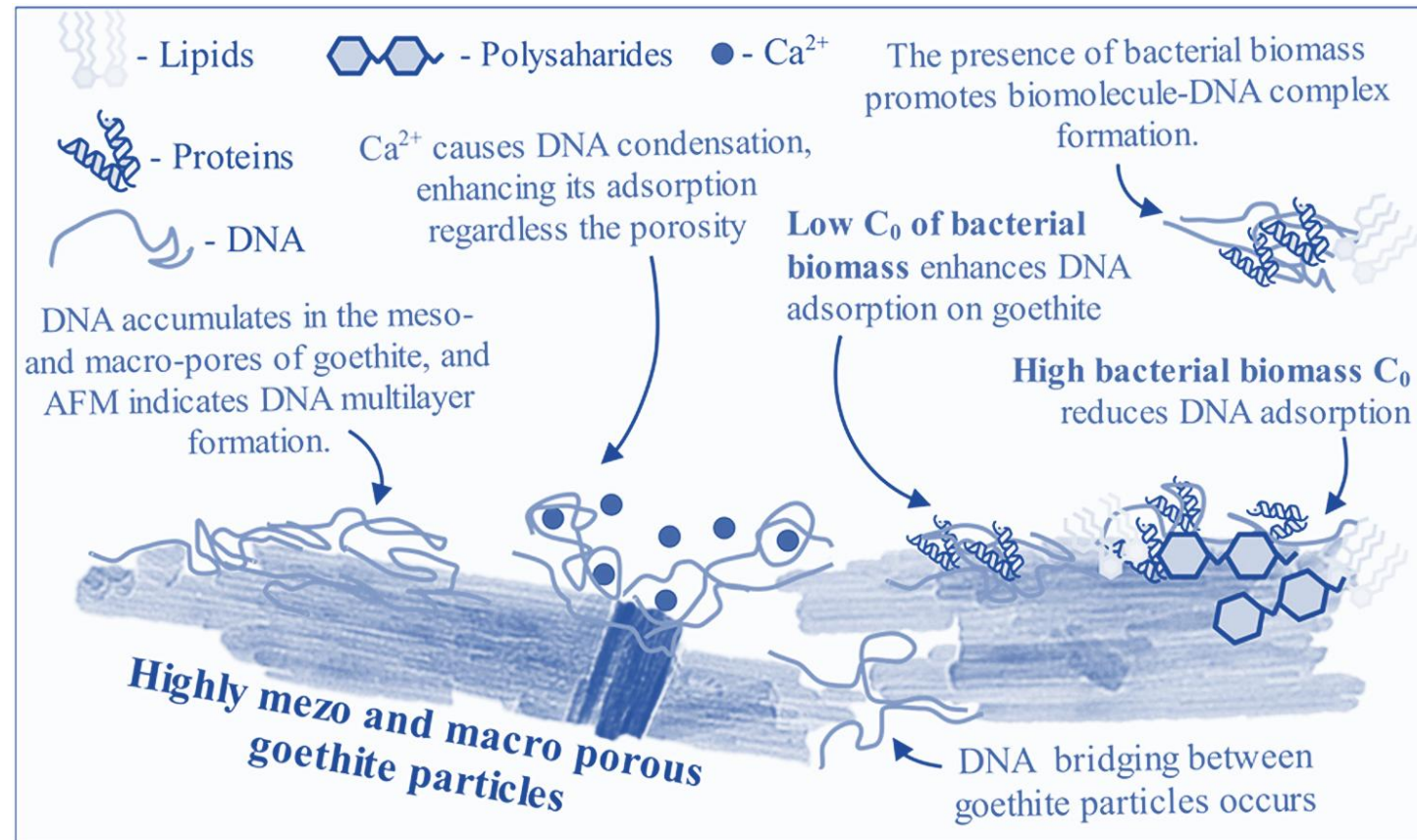
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Mineral sorbents can be used for the removal of DNA molecules (including free-floating virulent DNA / GMO-DNA) from aqueous solution.

Example of innovation:

Challenge: Validating various goethite minerals for DNA adsorption.

Result: DNA molecules tend to accumulate inside the meso- and macro-pores of goethite. Goethite-DNA interaction may govern the fate of antibiotic resistance and virulence genes contamination.



Engineered magnetic particles derived from steelmaking dust for phosphate recovery and immobilization of DNA from wastewater



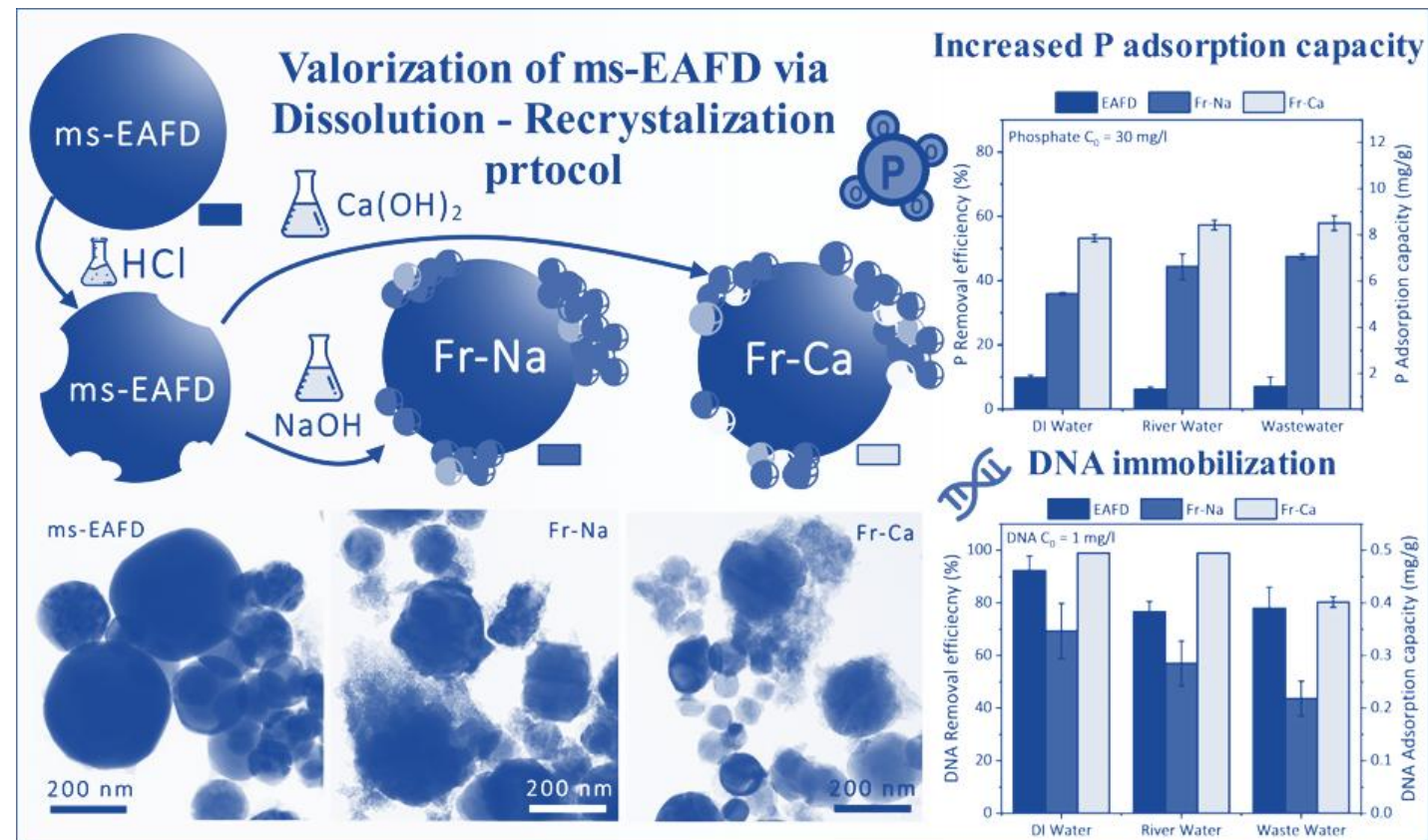
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Functionalised sorbents can be used for the joint removal of free-floating DNA contamination and nutrient recovery.

Example of innovation:

Challenge: Transforming steelmaking by-products into effective adsorbents.

Result: The development of reactive ferrihydrite coating resulting in producing functionalised sorbents with a high ability to remove phosphate and DNA from wastewater.



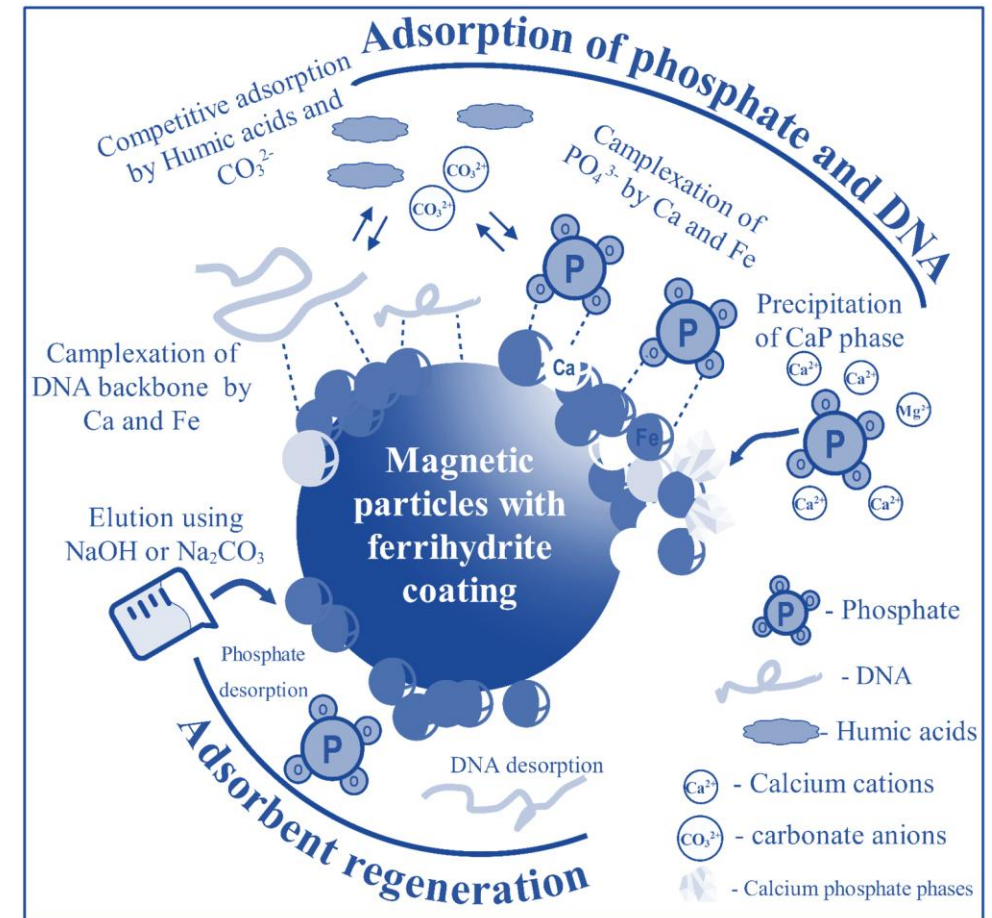
Where and how can we use developed sorbents?



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Example applications:

- Systems for final purification of wastewater or filters for tap water.
- Recovery of nutrients from wastewater.
- Production of DNA/RNA-based biosensors.
- Production of DNA/RNA isolation kits.



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<https://www.biol.uw.edu.pl/en/science-and-didactics/institute-of-microbiology/department-of-environmental-microbiology-and-biotechnology/>

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