

Introduction

With global plastic production reaching 430 million tonnes in 2023,¹ waste plastics are degraded into micro- and nanoplastic (MNPs) during erosion and crushing.² MNP pollution is considered one of the future's most serious global ecological hazards (Figure 1). It has become a research area of scientific and public interest.

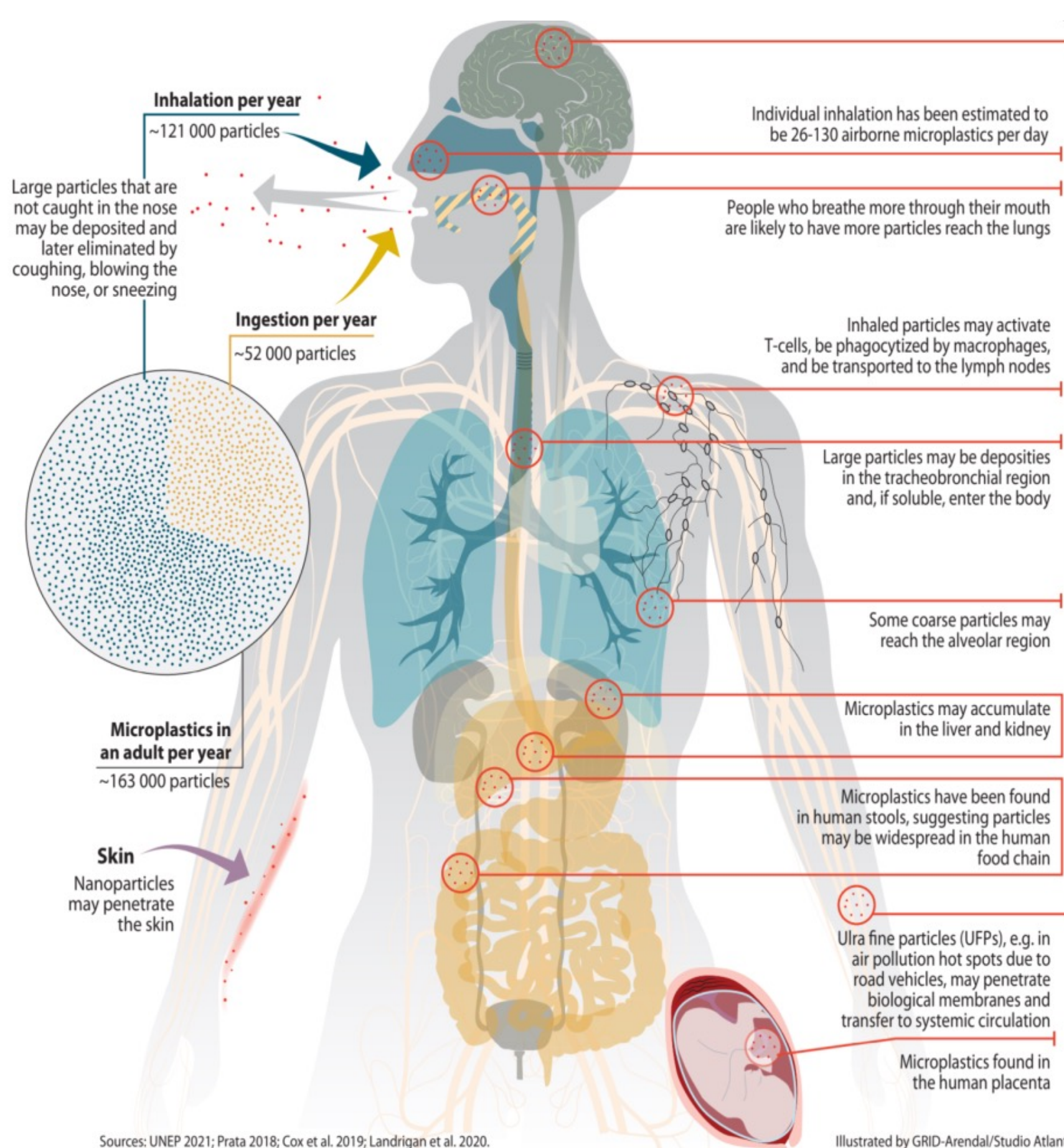


Figure 1. Human exposure to MNPs

Methodology

Regarding the CRM development, NIM has started the complex matrix CRM research project for the first time to meet real environmental analysis needs. Such CRMs with mass concentration as the characteristic value could provide metrology support for developing new methods and instruments. We have also researched the CRM of metal-doped MNPs (Figure 4). All this research could effectively support the health risks and toxicology research from the perspective of chemical metrology.

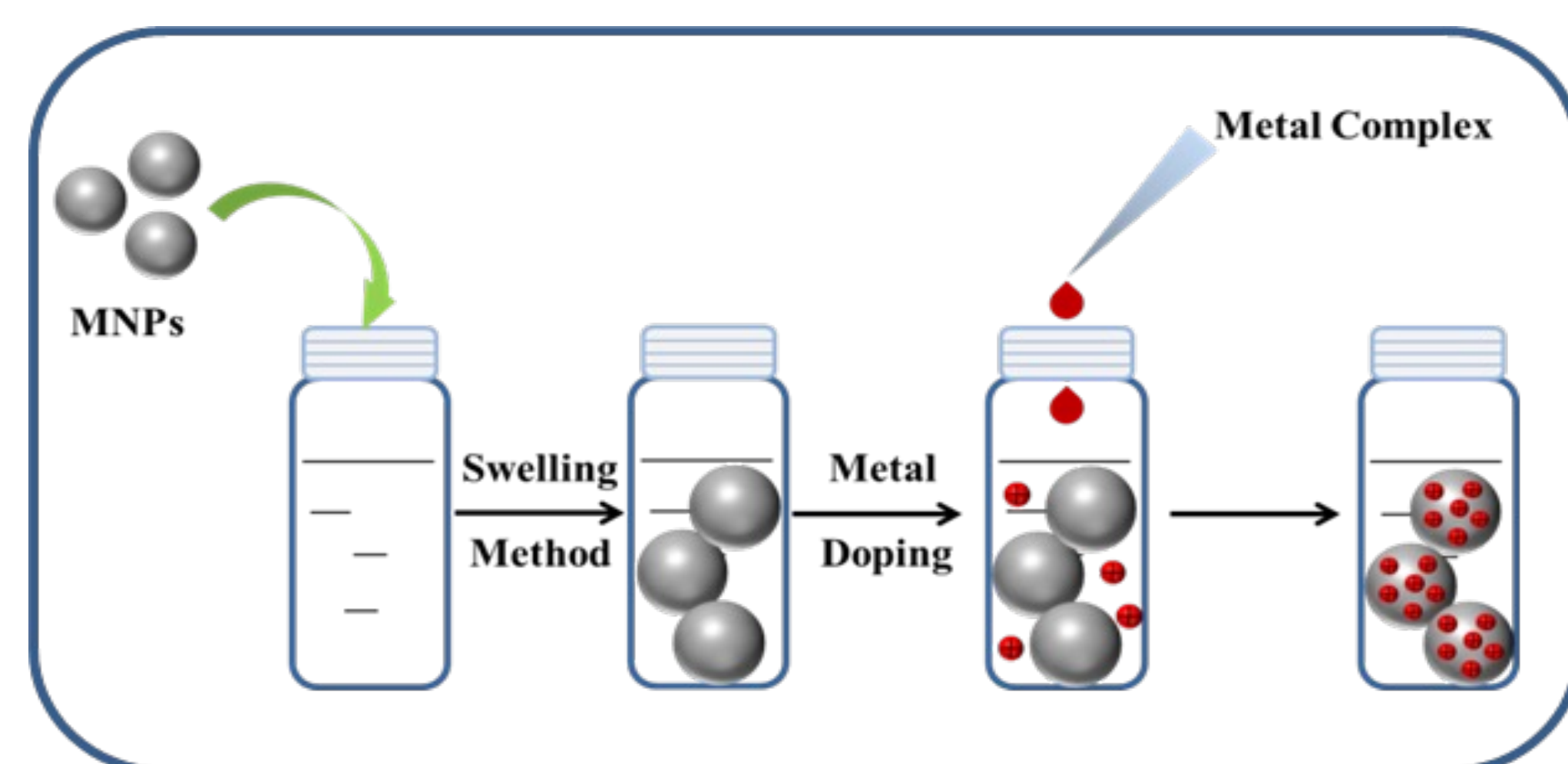


Figure 4. Metal-doped MNPs preparation process

Methodology

To obtain MNPs closer to those existing in real environments, we developed a preparation method of frozen grinding in our study, which includes the process of crushing, frozen grinding, and sieving of plastic raw materials, which requires the optimization of a series of parameters, such as grinding media, freezing temperature, etc (Figure 2).

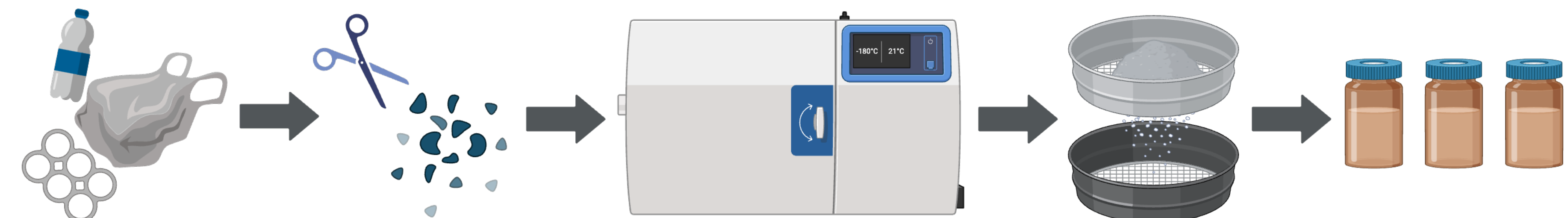


Figure 2. Flow chart of MNPs reference materials preparation

Methodology

Various mass-instrument-based measurement methods coupled with pyrolysis were also developed and optimized (Figure 3). With multi-dimensional measurement data, we aimed to provide valuable information on the present status of MNPs in the environment.



Figure 3. Measurement for mass concentration of MNPs

Results

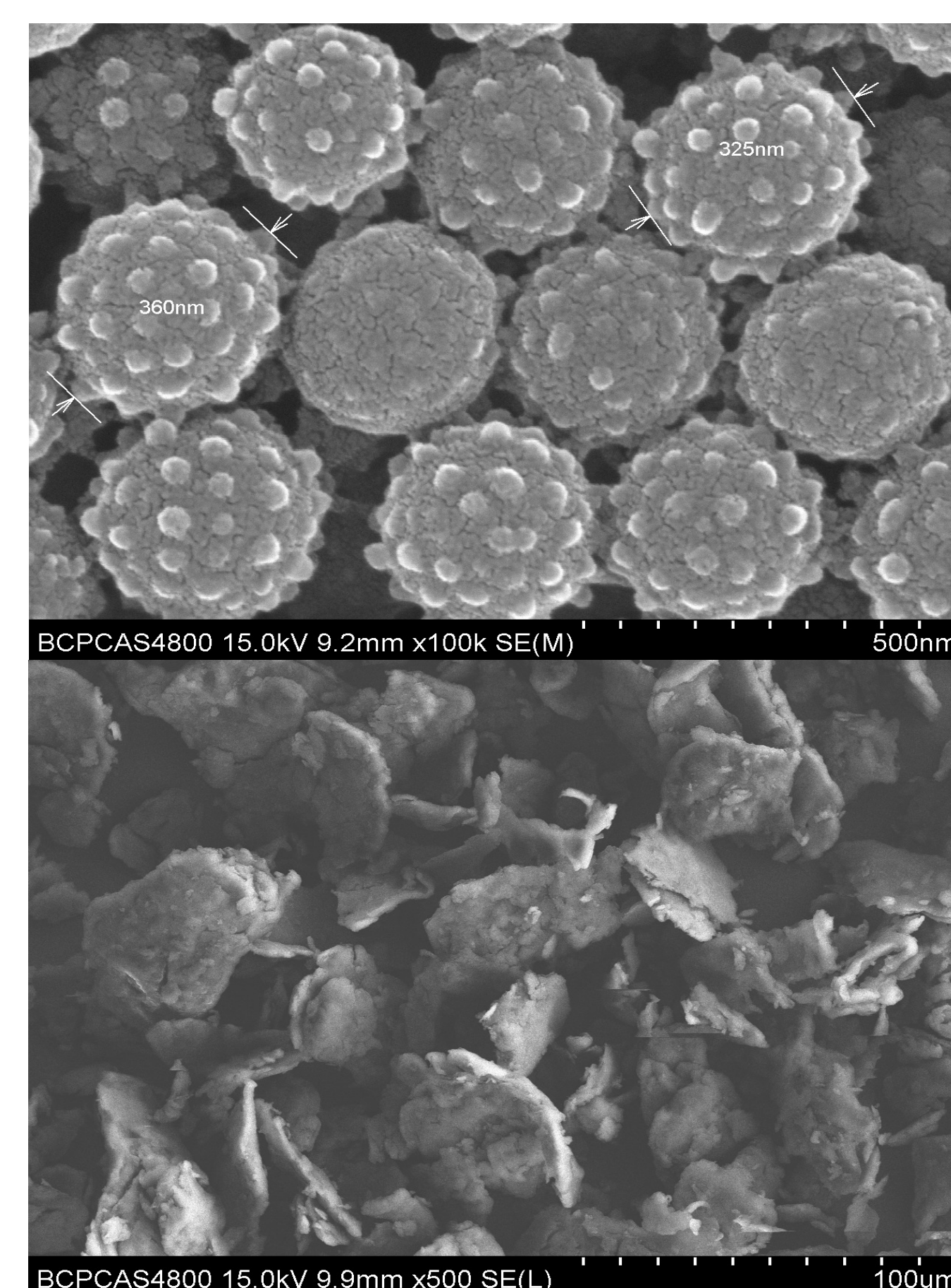


Figure 5. SEM characterization of prepared MNPs

Conclusion

MNPs with irregular morphology of different particle sizes and chemical compositions, were obtained to prepare MNPs under the restored real environmental conditions (Figure 5). The established techniques will be applied to the development of reference materials and support the research on the evaluation of environmental health effects of MNPs (Figure 6).

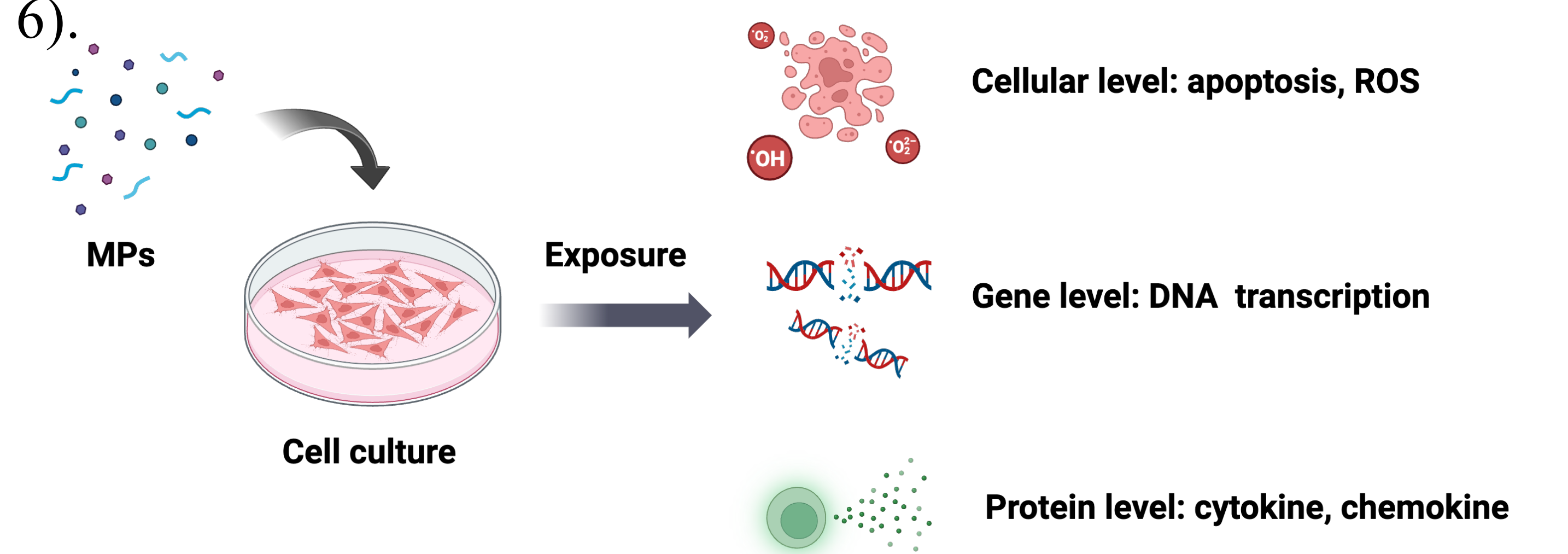


Figure 6. Evaluation of health effects of MNPs based on cellular modeling

References:

1. production, G. p., <https://www.statista.com/statistics/282732/global-production-of-plastics-since-1950/>.
2. Koelmans, A. A.; Redondo-Hasselerharm, P. E.; Nor, N. H. M.; de Ruijter, V. N.; Mintenig, S. M.; Kooi, M., Risk assessment of microplastic particles. Nature Reviews Materials 2022, 7, (2), 138-152.