▲ *Student artists created works related to groundwater as part of a larger project funded by the U.S. Environmental Protection Agency. Educators and artists-in-residence at the LUX Center for the Arts in Lincoln, Nebraska participated in an educator training workshop which translated into classroom lessons about groundwater through art.*

Art Exhibit Showcases Groundwater

The LUX Center for the Arts in Lincoln, Nebraska received a sub-award from the Groundwater Foundation to build an arts curriculum around the importance of groundwater in our lives as part of the Recharging Groundwater Education project funded by the U.S. EPA. The four artists-in-residence at the LUX Center, Owen Buffinton, Elise Loomis, Maria Spiess, and Taylor Wollwine, participated in an educator training provided by the Groundwater Foundation, which refreshed the artists' knowledge of groundwater concepts and identified parts of their curriculum that could be aligned with Nebraska's Arts and Science Standards.

The two ceramics artists led a clay-based project with elementary students, while the mixed media and painting artists developed drawing and painting-based lessons for the same ages, all centered around groundwater.

The final projects, completed by K-5 grade students from Lincoln elementary schools, were displayed at an exhibition that opened in the LUX Wake Gallery on March 1, 2019 and ran through the month of March. The work of student artists Kassandra Alvis, Silvia Foss, Vasya Mironov, Masha Mironova, Jasmine Pham, Zoe Pham, Johnathan Reyes, Kyquel Snyder, Almond Watkins, and Graham Wilkinson was featured.

Dozens of gallery-goers visited the Recharging Groundwater Student Exhibition during its opening reception. Dozens of students also visited the exhibit as a part of classroom and club curriculum.

A large painting and a three-dimensional clay sculpture depicted the role of groundwater in the water cycle and in people's daily lives. These projects were able to artistically show important groundwater concepts like the saturated zone, porosity, and groundwater flow as students demonstrated the many paths a water droplet can take through the water cycle.

The Groundwater Foundation's name, logo, and educational tools that were utilized within the art curriculum were prominently featured next to the names of the artists and students who completed this amazing project.

Microplastics Found in Groundwater

While it is widely known discarded plastic debris and microplastic contamination is widespread in surface water and aquatic ecosystems worldwide, an eye-opening study indicates the presence of microplastics in the groundwater aquifers we use for drinking water as well.

Led by a team of eight researchers, including Walton R. Kelly of the Illinois State Water Survey, the study found microplastic contamination in groundwater through karst aquifers, or open limestone systems that constitute about 25 percent of global drinking water. In the study, 16 out of the 17 groundwater samples collected from springs and wells from two karst aquifers in Illinois contained both microplastics and other contaminants like pharmaceuticals and personal care products.

According to the research, the open nature of karst aquifers makes them vulnerable to the rapid transport of surface-borne contaminants in dissolved and particulate forms. In addition to being important drinking water resources, kart ecosystems are habitats for rare faunal species that may be susceptible to contamination.

"In addition to the consumption of the particles themselves, microplastics may also be substrates that adsorb other contaminants such as pharmaceuticals, metals, or pathogenic microbes. From an ecological point of view, karst groundwater often discharges from springs to surface water, meaning microplastic contamination may be transferred to and affect the vulnerable ecosystems within the karst systems," said Kelly.

While the study focused on two aquifers in Illinois, Kelly hypothesizes microplastic contamination could be a broader issue. "Karst systems are

found around the world, and in the United States they are prevalent in the Midwest, Southeast, and Texas, with Florida made up of nearly 100 percent karst systems. Because these are notoriously vulnerable to contamination, there's every reason to expect to find microplastics in other karst aquifers."

The major question? What does this mean for human and ecosystem health? According to Kelly, this critical question needs to be further explored, citing a call for research in *The Lancet Planetary Health* titled Microplastics and human health – an urgent problem (found at https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(17)30121-3/fulltext).

As the research around microplastic contamination in karst aquifers and the potential health effects continues, Kelly says the ability for consumers to test or remediate microplastics in their water systems could be met with varying success.

"Some of these microplastics are actually visible to the naked eye; however, identifying and enumerating the contaminants is a specialized and time-consuming process with very few laboratories able to conduct this analysis for the public. Point-of-use filters could possibly remove any particles, but I don't personally know of any certified products on the market."

According to *Newsweek*, since plastics started being manufactured around 1950, humans have created more than 8,300 million metric tons of them. Of that, around 6,300 metric tons is waste, and only nine percent has been recycled. As much as 79 percent has ended up in landfills or in the natural landscape, including surface waters.

In addition to Kelly, the research team included Samuel V. Panno, Illinois State Geological Survey and lead author; John Scott, Illinois Sustainable Technology Center; Wei Zheng, Illinois Sustainable Technology Center; Rachel E. McNeish, California State University; Nancy Holm, Illinois Sustainable Technology Center; Timothy J. Hoellein, Loyola University, Chicago; and Elizabeth L. Baranski, League of Women Voters of Jo Daviess County.

The full article "Microplastic Contamination in Karst Groundwater Systems" is available free for a limited time through the Wiley Online Library at https://onlinelibrary.wiley.com/doi/full/10.1111/gwat.12862.

EPA Issues Guidance on Clean Water Act Permitting Requirements

On April 15, the U.S. Environmental Protection Agency (EPA) issued guidance clarifying the application of Clean Water Act (CWA or the Act) permitting requirements to groundwater. EPA's Interpretative Statement concludes that Congress excluded releases of pollutants to groundwater from the Act's permitting requirements and instead left regulation of those releases to the states and EPA's other statutory authorities.

EPA's Interpretative Statement provides certainty to states and the regulated community while recognizing long-standing protections for America's groundwater.

Consistent with Congress' vision for a strong federal state partnership to protect the country's groundwater resources, the agency's new guidance recognizes the state's leadership role in protecting groundwater and provides certainty to states and others who implement and enforce EPA's federal permitting programs. EPA's Interpretative Statement will help inform federal and state regulators with future National Pollutant Discharge Elimination System (NPDES) permitting and enforcement decisions.

States should continue to take an active role in regulating discharges to waters within their jurisdictions, as provided in state law and envisioned under the CWA. EPA will continue fulfilling its role in protecting groundwater and hydrologically connected surface waters as authorized by Congress through the Safe Drinking Water Act, the Resource Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.

Recent conflicting federal court decisions and the prior lack of clear agency guidance regarding whether NPDES permits are required for releases of pollutants to groundwater has caused uncertainty regarding how the agency and states should implement and enforce the NPDES permitting program. In February 2018, EPA requested public comment on whether the agency should revise or clarify its position on the issue. At the same time, the agency also undertook a comprehensive review of prior agency statements on the matter and performed a holistic analysis of the text, structure, and legislative history of the Act. Based on this analysis and careful consideration of public input, EPA concluded that Congress excluded releases of pollutants to groundwater from the Act's permitting requirements, regardless of whether there is a hydrological connection between the groundwater and a water of the United States.

In conjunction with issuing its Interpretative Statement, the agency is seeking additional public input regarding what may be needed to provide further clarity and regulatory certainty on this issue. The comment period will be open for 45 days after the Interpretative Statement is published in the Federal Register.

For more information visit https://www.epa.gov/npdes/releases-point-source-groundwater.