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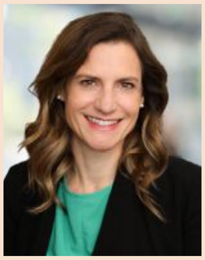
Citizen Science, Science as Publicized by the Media, and the Quality of Journal Publications

Citizen science—also called community science, participatory science, or crowdsourced science—has become a prominent and increasingly organized element in environmental data collection, public health discourse, regulatory proceedings, and litigation. What was once a relatively informal activity, in which members of the public contributed observations or samples to support professional researchers, has evolved into an increasingly well-funded, institutionally supported, and legally consequential field. Citizen science initiatives in the United States have contributed to changes in management practices, enforcement activities, and the generation of scientific knowledge valuable to policymakers. At the same time, the media's headline-tailored portrayal of scientific findings—often stripped of nuance, caveats, and methodological context—has created an environment in which preliminary or screening-level data can take on the authority of established fact before it has been subjected to rigorous (or any) evaluation. And the quality of journal publications themselves has come under scrutiny, as the peer-review process faces pressures that can reward provocative conclusions that are not necessarily supported by the data.



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These three phenomena—the rise of citizen science, the amplification of scientific claims through media, and the evolving reliability of journal publications each introduce distinct evidentiary challenges for environmental and toxic tort litigation. For the defense practitioner, these developments present both challenges and opportunities. Community-generated data reflect genuine concern, broad participation, and a desire for accountability—factors that resonate strongly with jurors, courts, and the public. But without proper quality assurance practices, citizen science may depart materially from professional standards; the distinction between concern and proof is one that the legal system must be equipped to draw. The question is not whether citizen science should be categorically admitted or excluded, but rather how it should be evaluated, contextualized, and communicated in adversarial proceedings and public forums.

This discussion examines the evolving landscape of citizen science in the environmental and toxic tort space, drawing on recent case studies, regulatory developments, and practical experience. It is intended to provide a comprehensive, balanced treatment of the subject—acknowledging the legitimate value and motivations behind citizen science while offering a clear-eyed assessment of its limitations, the risks of uncritical reliance on its outputs, and the strategies available to practitioners who must engage with citizen science evidence in litigation, rulemaking, and public discourse.

WHAT IS CITIZEN SCIENCE?

DEFINITIONS AND TERMINOLOGY

The term "citizen science" has been used broadly to describe a range of activities in which members of the public participate in the scientific process. The U.S. Environmental Protection Agency (EPA) describes citizen science as public engagement in advancing scientific knowledge through activities such as formulating research questions, collecting data, and interpreting results. Federal cross-agency guidance similarly defines citizen science as voluntary public participation in the scientific process, encompassing the formulation of research questions, conduct of scientific experiments, collection and analysis of data, interpretation of results, making of discoveries, developing technologies and applications, and solving complex real-world problems.

Terminology in this space has shifted in recent years. The EPA now uses the term "participatory science," and the former Citizen Science Association rebranded in 2024 as the Association for Advancing Participatory Sciences (AAPS). In some contexts, particularly where projects are initiated by members of environmental justice communities, the term "community science" is considered more appropriate. Throughout this paper, we use the term "citizen science" as a broadly applicable descriptive term, with the understanding that these various labels describe overlapping but sometimes distinct modes of public engagement with the scientific process.

TYPES OF CITIZEN SCIENCE

Citizen science projects can be categorized based on the nature and depth of citizen involvement. Hunter et al. provide the following framework:

- Collaborative projects are primarily led by professional scientists, with community members collecting and contributing data. In some cases, community members also perform data analysis or help disseminate findings. This is the most common model and includes many large-scale environmental monitoring initiatives.
- Co-created projects involve shared contributions from scientists and community members throughout the project lifecycle, from formulation of research questions to interpretation of results. These projects reflect a deeper partnership model and are increasingly common in environmental justice contexts.
- Collegial projects involve citizen scientists performing and disseminating research

Throughout this paper, we use the term "citizen science" as a broadly applicable descriptive term, with the understanding that these various labels describe overlapping but sometimes distinct modes of public engagement with the scientific process.

independently of professional scientists. While less common, this model raises the most significant questions about data quality, methodological rigor, and the boundary between scientific inquiry and advocacy.

THE CROWDSOURCING AND CITIZEN SCIENCE ACT

The Crowdsourcing and Citizen Science Act was enacted as part of the American Innovation and Competitiveness Act in 2017. The Act established the first federal statuary definition of citizen science codified as “a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways.” Importantly, the Act grants federal agencies explicit authority to use citizen science to conduct research and advance their missions and federal agencies to compile and report on their citizen science activities.

INSTITUTIONAL GROWTH AND INFRASTRUCTURE

Following the passage of the Crowdsourcing and Citizen Science Act, EPA released its “vision and principles” for participatory science, articulating a high-level strategy comprised of three core principles: good science, community involvement, and informed decisions.

EPA’s quality-assurance materials for participatory-science projects were developed to help organizations document scientific methods, complete a Quality Assurance Project Plan (QAPP), and enable data users to evaluate the quality of data collected by the public. EPA’s policy guidance likewise identifies project-design requirements and design considerations that may apply to participatory-science efforts, including scientific integrity, records management, and environmental information quality requirements.

Professional organizations have also helped broaden the field’s practical reach. AAPS is an international professional society that organizes conferences and webinars, provides resources to implement citizen science projects, and sponsors a peer-reviewed, open-access journal called “Citizen Science: Theory and Practice.” According to AAPS, “The participatory sciences are expanding the reach, relevance, and impact of science in almost every area of inquiry; in the field and online; through local and global efforts.”

THE PROMISE AND PERSUASIVE POWER OF CITIZEN SCIENCE

WHY CITIZEN SCIENCE HAS PROLIFERATED

Public contribution to science is not a recent phenomenon. Amateurs and interested citizens have contributed to scientific discovery for centuries, although their contributions largely went unrecognized in scientific publications. Over the past few decades, citizen scientist contributions have been increasingly recognized by the scientific community and have earned increased attention.

In today’s current climate, citizen science has significant appeal. It generates large datasets across wide geographic areas at relatively low cost. It endorses engagement by affected communities. And it embodies values—transparency, democratic participation, accountability—that resonate powerfully with jurors, courts, regulators, and the general public at large.

Several factors have driven the expansion of citizen science and its growing legitimacy. Public mistrust of regulatory agencies has fueled demand for independent, community-driven data collection Federal investment, , directed funding toward environmental justice communities and the monitoring programs they support. Technological advances have dramatically increased the availability and accessibility of monitoring technology. Air sensor systems, for example, are generally lower in cost, more portable, and easier to operate than regulatory-grade monitors, making them accessible to users outside traditional regulatory programs. EPA’s updated Enhanced Air Sensor Guidebook was itself produced in response to increased sensor availability, a growing user base, and the need for current best practices on project planning, sensor selection, data handling, performance interpretation, and study design.

POTENTIAL IMPACT IN LITIGATION

The potential power of citizen science in litigation deserves particular attention. In many cases, community concern and the data it generates may in fact represent the most honest available signal that something is wrong. When a group of citizens organizes to document environmental changes in

Data integrity is also compromised when the dataset does not represent reality but instead reflects sampling biases.

their neighborhood, they are recording the real lived experiences of their community. Independent of the scientific validity of the data, that lived experience brings moral weight that jurors, courts and the public respond to.

However, the persuasive power of community concern does not necessarily track with its scientific reliability, and the conflating the two creates serious problems in litigation. The Flint water crisis relief program is a concrete example of this failure. Community-generated narratives about bathing water quality, unsupported by representative sampling or validated analytical methods, were amplified through media channels and produced measurable public health confusion.

Ascribing unwarranted scientific validity to community-generated data because of its perceived moral authority is a that not only may be inconsistent with established legal standards (such as the burden of proof) but must also be overcome by defendants in litigation, and this presumptive weight does not depend on methodological rigor, which is often unexamined or absent.

This can create a fundamental asymmetry in environmental and toxic tort litigation. The party relying on citizen science data benefits from the moral authority of community engagement, while the party challenging that data bears the burden of explaining why good intentions do not guarantee good science—a message that can easily be perceived as dismissive or self-serving if not communicated with care. How courts and litigators should acknowledge the legitimacy of citizen concern without conflating concern with scientific reliability is one of the central questions this panel will explore.

SCIENTIFIC RIGOR AND DATA QUALITY IN CITIZEN SCIENCE

THE "FIT FOR PURPOSE" FRAMEWORK

The most central framework for evaluating citizen science data in environmental litigation is also the simplest: what was the data designed to establish, and what is it being asked to show?

EPA's Guidelines for Human Exposure Assessment expresses this principle as "fit for purpose", or the idea that assessments should be planned and structured to be suitable for their intended purpose. Applied to citizen science, this concept helps distinguish between data that may appropriately support screening, prioritization, pattern recognition, or follow-up investigation and data that are being invoked for unsupported conclusions about exposure, risk, or causation than the underlying methods can bear.

When it comes to air monitoring, for example, EPA's sensor guidance consistently frames air sensors in non-regulatory, supplemental, and informational monitoring contexts and identifies uses such as examining local air-quality trends, identifying hotspots, and helping identify sites for additional regulatory monitoring. These are valuable functions. But they are categorically different from establishing community-wide exposure concentrations, time-weighted exposure estimates, or human doses sufficient to support conclusions about health risk or legal causation.

QUALITY CONTROL

Data integrity issues arise at all phases of citizen science: study planning and structure, data handling, and data interpretation. Quality control problems in citizen science projects frequently include a lack of standardized protocols or adherence to protocols (including the absence of a QAPP); inadequate documentation of methods and procedures; variable training and skill levels among participants; and equipment and environmental interference.

In the context of air monitoring, lower-cost sensor systems present particular challenges. EPA's Performance Testing Protocols document ongoing issues, including sub-parts-per-billion detection limits that remain problematic for accurate sampling of many air toxics; interference from humidity (relative humidity above 80% can cause errors of ±30%); calibration drift (10–20% per month is typical); unknown sensor response to complex chemical mixtures; and the absence of data verification and validation procedures such as reference data comparison, chain of custody protocols, traceability, and laboratory standard operating procedures.

These shortcomings do not necessarily reflect bad faith. Many citizen science participants may be genuinely dedicated to collecting accurate information and acting in good faith. But their own non-professional limitations and these other technical limitations materially affect data reliability and interpretability in ways that are not always apparent to non-technical audiences (i.e., juries and judges).

DATA REPRESENTATIVENESS

Data integrity is also compromised when the dataset does not represent reality but instead reflects sampling biases. Representative monitoring data generally depend on a structured sampling design, including defined locations, consistent timing, and specified observation periods. By contrast, opportunistic measurements collected whenever and wherever conditions appear notable may still be useful for screening or source scouting, but they are less suited to robust statistical estimation of typical conditions or community-scale exposure patterns.

Common biases in citizen science data collection are well-documented in the scientific literature.

- Spatial bias arises because locations for data collection are often those that are most convenient for volunteers, rather than those that are statistically representative of the area or population of interest.
- "Weekend bias" refers to the fact that data collection typically occurs only during times when volunteers are available, which may not be representative of the full range of conditions.
- Varying expertise and varying methods introduce variability in capabilities and performance among volunteers, and different standards of thoroughness can produce data that are internally inconsistent.

For risk assessment, the relevant question is not simply where a monitor was placed, but whether the resulting data reasonably represent the exposure setting of the population of interest. As noted above, EPA's exposure-assessment framework centers on the exposed population, the relevant pathway, and the concentration at the point of contact—not on a localized measurement in isolation. A single-location reading may be useful for source identification or screening, but it does not by itself characterize community-scale exposure. The interpretive error arises when spatially limited measurements are treated as though they directly represent broader population exposure.

A related limitation is temporal mismatch: data-collection periods that do not correspond to the exposure timeframe of interest. Short monitoring windows may identify episodic conditions, but they do not characterize chronic exposure patterns.

DETECTION IS NOT EXPOSURE, AND EXPOSURE IS NOT HARM

A consequential interpretive error in citizen science litigation is the conflation of detection, exposure, and harm.

Establishing any one of them does not establish the others. A measured concentration at a fenceline, roadside, or mobile location is not, by itself, a measure of personal exposure, dose, or health risk. Translating a field measurement into a meaningful exposure estimate requires information about who was present, for how long, at what concentration, and by what pathway – A three-step inferential chain that requires specific expertise not provided by most community monitoring programs.

This distinction is critically important in litigation. Plaintiffs and advocacy groups frequently present monitoring data as though the detection of a chemical at any concentration is synonymous with harmful exposure, or worse yet, proof of causation. But the principles of toxicology—particularly dose-response—require more than the mere presence of a substance. A person must be present for an exposure to occur, and the exposure must be at a sufficient concentration for a sufficient duration to cause a health effect that is shown in the scientific literature to be causally associated with that effect. In other words, detection is not exposure, and exposure is not harm.

CONFIRMATION BIAS

Community-generated monitoring often begins with a pre-existing concern or working hypothesis about a source, and that starting point can create a risk of confirmation bias if the monitoring design is not structured to test alternative explanations. When investigators expect to find a pattern, study execution and classification can drift toward confirming that expectation unless the design contains safeguards.

EPA's participatory-science and air-sensor guidance expressly require projects to define the purpose for monitoring, the questions to be answered, and the intended use of the data before collection begins. That structure is sensible and often necessary. But it also means that, where a project is organized around an expectation that a particular facility is causing harmful exposures or community health problems, study design choices—such as monitor placement, timing, analyte selection, and event-focused deployment—may become vulnerable to confirmation bias unless the protocol is designed to test alternative explanations and document quality objectives in advance.

MORE DATA DOES NOT EQUAL BETTER DATA

A particularly dangerous

assumption in citizen science—and one that recurs in both litigation and public discourse—is that sheer volume of data compensates for methodological flaws. Collecting 100, 1,000, or 10,000 samples using improper methods does not make the average result more accurate than 10 flawed samples. Replication of error is still error.

Yet in litigation and public discourse, large datasets are often treated as self-validating. Statistical aggregation is mistaken for methodological rigor. This problem is exacerbated by the use of means, medians, regressions, confidence interval manipulations, and other forms of reducing the presentation of "noise" in a large dataset to make it seem more convergent. Quantity cannot substitute for quality, and scale does not cure bias or systematic error.

Vohland et al. have identified several recurring data quality problems in citizen science: data collection protocols are not followed by participants; protocols do not match the goals of the project or the probable participants; protocols are incorrectly implemented; protocols are not comprehensive and are used by stakeholders with different data quality expectations; and data are used for purposes for which they are not fit. Each of these problems is compounded, not cured, by larger sample sizes.

In adversarial proceedings, a massive dataset can create an aura of authority that obscures underlying methodological weaknesses. Courts and juries may be particularly susceptible, because the intuition that "more data is better" is strong and not always wrong. The challenge for attorneys is to explain, clearly and without condescension, why the question is not how much data was collected, but how it was collected—and whether the methods can support the conclusions being drawn.

Importantly, high-quality data are not always the goal; what matters for evaluating citizen science is whether the level of quality is known and documented. Full reproducibility is not always achievable in field-based environmental monitoring, but at a minimum it should be possible to reconstruct what was done: what was collected, where, when, and by whom; how samples moved from collection to analysis to reporting; and what quality assurance procedures were followed.

MEDIA AMPLIFICATION, ADVOCACY, AND THE QUALITY OF JOURNAL PUBLICATIONS

THE AMPLIFICATION PROBLEM

The rise of citizen science cannot be understood in isolation from the media and advocacy ecosystem in which it operates. Scientific findings—including preliminary, screening-level, or methodologically limited findings—are routinely amplified through media coverage, advocacy platforms, and social media in ways that strip away nuance, context, and appropriate uncertainty.

Consumer Reports investigations, for example, those involving PFAS in consumer goods, often rely on limited sampling designed for consumer awareness rather than forensic or litigation purposes. These results can be misused when repurposed as proof of exposure, dose, or harm in legal proceedings. Additionally, advocacy platforms such as Mamavation frequently amplify testing results related to PFAS in clothing, childcare articles, and consumer products, leading to misinterpretation of analytical results, failure to distinguish detection from risk, and the conflation of presence with harm through the ignoring of exposure pathways and dose.

Social media creates feedback loops in which erroneous or overstated conclusions are rapidly amplified without nuance or acknowledgment of uncertainty. Corrections almost never travel as far as alarming claims. The result is an information environment in which preliminary data can acquire the force of established fact in public discourse long before they have been subjected to rigorous scientific evaluation. This phenomenon has direct consequences for litigation: it shapes jury pools, may influence judicial perceptions, creates background assumptions that regulators must navigate, and generates pressure on companies to settle claims that may lack scientific merit.

JOURNAL PUBLICATION QUALITY

The quality and reliability of journal publications have also come under increasing scrutiny. Across environmental litigation more broadly, there is a growing tendency to prioritize results over process and methodology. The scientific community and the peer-review process can reward conclusions over uncertainty, diminishing attention to what might be described as "boring but critical" details: sampling methodology and representativeness; equipment standards and calibration; sample preparation and handling; blanks, controls, and duplicates; chain of custody; and QA/QC documentation and transparency.

This trend has particular relevance in the citizen science context, where university-affiliated research funded by advocacy organizations may be published in peer-reviewed journals and then enter public discourse with the credibility ordinarily associated with journal publication—even when the underlying data were collected through methods that would not satisfy regulatory or forensic standards—or were not scrutinized as would normally be required for inclusion in peer-reviewed journals. The Louisiana ethylene oxide case study discussed below provides a striking example of this dynamic: a Johns Hopkins study funded through Bloomberg Philanthropies' Beyond Petrochemicals campaign was published in a peer-reviewed journal and then entered the public record with the imprimatur of academic credibility, notwithstanding significant questions about the relationship between the measured data and the health conclusions being drawn.

The mere fact that a study has been published in a peer-reviewed journal does not insulate it from scrutiny regarding methodology, data quality, or the appropriateness of its conclusions. Peer review is a valuable but imperfect quality control mechanism, and practitioners should be prepared to look behind the journal citation to evaluate the underlying science on its merits.

CASE STUDIES

A REFINERY-FOCUSED COMMUNITY-LED AIR MONITORING PROGRAM (COMMERCE CITY, COLORADO)

Colorado provides several high-visibility examples of how community-led initiatives can move quickly into media, advocacy, regulatory, and litigation settings. The American Lung Association's 2026 report on community air monitoring describes the Commerce City case as one in which community monitoring, agency action, and facility-specific monitoring requirements developed in the same geographic setting rather than as separate, unrelated efforts. The project has been repeatedly referenced as one of the most comprehensive citizen science air monitoring efforts conducted near a major industrial facility in Colorado.

In March 2020, Colorado announced a $9 million settlement with Suncor Energy (U.S.A.) to resolve air-quality violations at the Commerce City refinery. Of that funding, Cultivando, a community nonprofit organization, received $2.6 million to oversee an air monitoring program (the Cultivando AIRE project) implemented by an atmospheric scientist formerly a professor at CU Boulder, and to conduct a survey of symptoms experienced by residents living around the Suncor refinery. The air monitoring program included stationary low-cost sensors and fixed and mobile monitoring units, with a goal of tracking more than 100 chemicals in the air, with a specific focus on connecting air quality with community health concerns believed to be related to emissions from Suncor's operations.

Although the Cultivando AIRE project was a comparatively well-supported citizen-science monitoring effort with analytical protocols led by an academic researcher, data integrity issues were evident from the start. Project materials and public statements framed the work around concern that Suncor was contributing to community health harms, including a project agreement focused on the health impacts of Suncor's operations, public statements describing cumulative toxic exposure from the refinery, and reporting that the monitoring results confirmed long-held suspicions about dangerous pollution near the facility. Those facts do not invalidate the monitoring, but they underscore why protocol safeguards and alternative-source evaluation matter.

The health survey conducted as part of the project was fraught with bias. Cultivando's website stated that the survey was "Driven by concern about the impact of emissions from the nearby Suncor oil refinery on their families' health," and that between November 2022 and June 2023, residents "documented a range of health problems they believed to be linked to air pollution. "The inferences drawn from the monitoring were communicated through a public-facing real-time data platform, in-person community meetings, local commission meetings, presentations to state regulators, and the media.

Cultivando concluded that the monitoring identified a total of 129 chemicals, including particulate matter and volatile organic compounds (VOCs), and that "worryingly" three chemicals were detected at Suncor's fenceline and in the community. However, the project did not put the data into appropriate perspective—conflating detections with risk and harm, without recognizing that chemicals detected at the fenceline and in the community are also widely detected in ambient air in highly industrialized areas. Nonetheless, Cultivando conflated detections of chemicals and the breadth of data with the conclusion that Commerce City residents were breathing air "laden with pollutants that pose a serious health risk." Media outlets reported on Cultivando's conclusions and called for stricter regulation due to potential health risks from refinery pollution without independently verifying their accuracy.

The regulatory and litigation consequences were significant. In May 2023, the Air Quality Control Commission adopted the disproportionately impacted community permitting rule under Regulation 3 in response to the Colorado Environmental Justice Act, adding enhanced modeling and monitoring requirements in disproportionately impacted communities. In that rulemaking, Earthjustice represented Cultivando and used the Commerce City monitoring results together with resident testimony to support more stringent regulation. The same interpretive error persisted: short-term monitoring "spikes" were treated as though they established chronic exposure, risk, and health harm, when such measurements may support screening, prioritization, or further investigation but do not, without additional exposure characterization and toxicological analysis, establish dose, causation, or facility-specific injury.

The pattern later carried into litigation. In August 2024, GreenLatinos, 350 Colorado, and Sierra Club filed a Clean Air Act citizen suit against Suncor Energy (U.S.A.) Inc., alleging that continuing refinery violations harmed nearby residents and the surrounding environment. Although Cultivando was not a named plaintiff, its monitoring work arose from the same Commerce City and North Denver advocacy setting in which emissions information, resident testimony, and public health claims were being assembled for both regulatory and litigation use.

The Colorado record illustrates a critical distinction: even though community-generated monitoring may carry regulatory relevance as evidence for rulemaking, it may not meet the evidentiary standards required to establish exposure, causation, or harm in litigation.

ETHYLENE OXIDE AND PETROCHEMICAL FACILITIES (LOUISIANA)

The Louisiana ethylene oxide dispute provides a useful case study of how community monitoring, journal publication, media amplification, and legal conflict can converge to give screening-level information the appearance of definitive evidence of health harm.

Louisiana had already become a center of dispute over industrial air pollution and community-led monitoring, with public reporting in 2024–2026 describing expanding grassroots monitoring efforts in heavily industrialized communities along the Mississippi River corridor. Around the time federal funding for citizen science projects was being reduced, Bloomberg Philanthropies launched a Beyond Petrochemicals campaign to halt the rapid expansion of petrochemical and plastic pollution in the United States, support frontline communities, and fund research and monitoring connected to that mission.

Against that backdrop, a Johns Hopkins School of Public Health study was published that reported mobile monitoring results for ethylene oxide from a 75-kilometer portion of the southeastern Louisiana industrial corridor. The study stated that many measured concentrations exceeded levels corresponding to EPA excess-cancer-risk benchmarks under lifetime exposure assumptions, while also estimating tract-level ethylene oxide concentrations higher than EPA-modeled values. At the same time, the public-facing funding trail showed that the academic research was funded through Bloomberg Philanthropies' Beyond Petrochemicals campaign—an initiative publicly described as aiming to halt the rapid expansion of petrochemical and plastic pollution in the United States.

This paper is important for what it represents in the larger evidentiary story: a university-affiliated publication in a peer-reviewed scientific journal arising from a campaign-supported monitoring environment and then entering public discourse with the credibility ordinarily associated with journal publication. Data that may be technically sophisticated or publicly compelling still must be evaluated under the established framework of exposure science and risk-based evidence before they can support valid conclusions about health risk. That distinction is especially important for ethylene oxide, where background levels must be considered and cancer risk depends on long-term exposure over many years—not a measured spike, short-term plume, or isolated detection.

Louisiana's statutory response underscores how high the stakes had become. The Louisiana Community Air Monitoring Reliability Act (CAMRA) took effect on May 23, 2024. The codified law states that it was enacted to establish standards requiring that programs seeking to allege violations or noncompliance must use science-based standards, EPA-approved methods, laboratory analysis, or quality-assurance certification. The law also set out requirements for communication of results, including clear explanations, context, and data limitations and uncertainties. Violating CAMRA's communication or reporting requirements can lead to fines of up to $32,500 per day and $1 million for intentional violations.

In May 2025, community groups filed a lawsuit alleging that the Act is a "de facto ban" on community monitoring because, in part, regulatory-grade equipment is cost-prohibitive and that the law violates their rights to free speech and petition and conflicts with the Clean Air Act and federal programs encouraging broader use of air sensors. The Louisiana situation thus encapsulates the tension at the heart of the citizen science debate: how to encourage community participation in environmental monitoring while ensuring that the data generated are evaluated with appropriate rigor before being used to support legal, regulatory, or public health conclusions.

TIRE WEAR CHEMICALS AND 6PPD-QUINONE

The tire wear chemicals and 6PPD-quinone (6PPD-Q) issue presents a somewhat different case study that illustrates the intersection of citizen science databases, environmental advocacy, and emerging contaminant litigation.

The website tireweartoxins.com hosts a database that aggregates citizen-generated sampling results for surface waters and a chemical related to key tire ingredients called 6PPD-Q. The website and its database have become frequently referenced in litigation narratives and public advocacy. But key questions and elements of sound sampling are often left unaddressed or underexplored by tireweartoxins.com and those who cite it, including: how sampling locations were selected and whether they are representative; whether collection methods were consistent across contributors; what sample preservation and contamination controls were used; what analytical methods and laboratory comparability standards were applied; and what QA/QC and chain of custody documentation exists.

Data from the database are sometimes presented as definitive evidence of environmental harm or exposure without adequate context. The existence of a large, publicly accessible database can create an aura of authority that exceeds the underlying methodological support. The 6PPD-Q issue also illustrates the complexities of emerging contaminant science. Unlike long-lasting pollutants such as PFAS, 6PPD-Q breaks down relatively quickly in the environment, and scientists are still working to understand how it behaves, including how fast it degrades, how organisms are actually exposed to it, and what harm it could cause to aquatic life. The samples comprising the tireweartoxins.com database are largely grab samples, reflecting a static concentration at a specific point in time. A special sampling method, called passive sampling, may give a more realistic picture of what fish and other sensitive species actually encounter in the water. Rather than capturing a single snapshot of contamination at one moment in time, passive sampling collects data over a longer period across multiple storm and runoff events, reflecting the natural ups and downs in concentration levels. This matters because current research suggests that aquatic species are primarily sensitive to the portion of 6PPD-Q that is dissolved in water, not the total amount present (which may include particles that organisms cannot absorb). But the distinction between the total amount detected in a water sample and the smaller "dissolved fraction" that actually affects aquatic life is a technical one that often gets lost in public debate and legal arguments, where the higher "total" number may be cited without this important context.

The tire wear toxins case study raises a fundamental question for courts: how should they weigh citizen databases that are transparent and well-intentioned, but methodologically inconsistent and difficult to reconcile with established scientific standards?

RISKS AND STRATEGIES FOR THE PRACTITIONER

THE RISK OF BEING DISMISSIVE

Attacking citizen science too aggressively can appear condescending, anti-community, and anti-transparency. That approach

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can backfire with juries and regulators. The communities that produce citizen science data are often the same communities that allege to have borne disproportionate environmental burdens.

Inside the courtroom, effective advocacy requires respect for citizen engagement and efforts, coupled with clear explanations of why methodology matters. Advocates must avoid high-handed credential-bragging while still asserting that experience and qualifications are important to the interpretation of complex scientific data. The tone should be one of engaged seriousness: "We take this data seriously, which is exactly why we want to make sure it is evaluated carefully."

COMMUNICATING THE IMPORTANCE OF "MUNDANE" DETAILS

One of the hardest challenges in environmental litigation is explaining why things like sampling protocols, equipment calibration, and QA/QC procedures—though tedious and unexciting—truly matter to the accuracy and reliability of scientific data and conclusions. This is perhaps the most important communication challenge for defense practitioners: making rigor understandable without sounding dismissive.

Analogies can be powerful. Most jurors understand that a medical diagnosis requires more than symptoms—it requires tests, imaging, expert interpretation, and consideration of alternative explanations. Similarly, an environmental "detection" is not a "diagnosis" of harm. Just as a fever could indicate many conditions, a chemical detection requires context: how much, for how long, by what pathway, and compared to what baseline. The goal is to make the audience understand that the careful, methodical work of science is not an obstacle to the truth but the path to it.

Another effective approach is to acknowledge what the data do show, rather than focusing exclusively on what they do not. If citizen science data identify a localized condition that warrants further investigation, saying so demonstrates good faith and scientific literacy. The argument is not that citizen science found nothing of interest; it is that what was found requires further, more rigorous evaluation before it can support conclusions about exposure, causation, or harm.

DISTINGUISHING BETWEEN SCREENING AND PROOF

A particularly useful framework for juries and courts is the distinction between screening-level data and proof of harm. Screening data are valuable: they can identify areas of concern, prioritize further investigation, and focus resources on the most important questions. But screening is, by definition, a first step—not a conclusion. The challenge arises when screening-level data are presented as though they establish facts that they cannot support.

This distinction is not an attack on citizen science. It is a recognition that different types of data serve different purposes, and that using data beyond their appropriate scope does a disservice to everyone—including the communities that collected the data and the individuals whose health and legal interests are at stake.

CONCLUSION AND KEY TAKEAWAYS

Citizen science is neither inherently unreliable nor inherently trustworthy. Its value depends on the rigor of its methods, the appropriateness of its application, and the honesty with which its limitations are acknowledged. As the field continues to grow in institutional support, technological capability, and legal significance, practitioners on all sides of environmental and toxic tort disputes must develop the ability to engage with citizen science evidence thoughtfully and critically.

SEVERAL KEY TAKEAWAYS EMERGE FROM THE DISCUSSION ABOVE.

First, citizen science is here to stay, and its influence in litigation, regulation, and public discourse will only increase. The expansion of institutional support, the availability of low-cost monitoring technology, and the growing emphasis on environmental justice all point toward a future in which community-generated data play an even larger role in environmental decision-making.

Second, volume of data does not compensate for flawed methodology. This is a point that bears repeating because it runs counter to a powerful intuition. The question is not how much data was collected, but how it was collected and whether the methods can support the conclusions being drawn.

Third, public amplification through media, advocacy platforms, and social media can distort scientific meaning and legal relevance. Preliminary findings can acquire the force of established fact before they have been rigorously evaluated, and corrections rarely travel as far as the initial alarming claims.

Fourth, lawyers must engage citizen science thoughtfully and critically. The effective approach is to acknowledge the legitimacy of the concern, take the data seriously, and then explain clearly and accessibly why the data require further evaluation before they can support the conclusions being drawn.

Fifth, the central challenge is communication—making rigor understandable without sounding dismissive or condescending. This is the hardest part, and it is where the art of advocacy intersects with the science of evidence. The practitioners who master this challenge will be best positioned to serve their clients, assist the courts, and contribute to a more accurate and honest public discourse about environmental risk.

Finally, the legal and regulatory landscape is evolving rapidly. The Louisiana CAMRA statute, the Colorado Environmental Justice Act, Clean Air Act citizen suits, and the ongoing debate over the appropriate use of community-generated data in regulatory proceedings all signal that the rules of engagement are still being written. Practitioners who understand the science, respect the communities, and communicate clearly will be the ones who shape those rules.