U.S. Environmental Protection Agency Implementation of Gold Standard Science

Based on Executive Order No. 14303 "Restoring Gold Standard Science"

Overview

The U.S. Environmental Protection Agency (EPA) has an important mission to protect human health and the environment. The Agency recognizes the critical importance of scientific integrity and Gold Standard Science in scientific activities, including research, applied science, and the use of environmental information and data as part of performing the EPA's statutory functions. The EPA is committed to upholding the principles of Gold Standard Science to ensure that the EPA's decisions and policies are informed by credible, reliable, and impartial scientific evidence available.

On May 23, 2025, President Trump signed Executive Order (EO) 14303, "Restoring Gold Standard Science,"[1] which focuses on ensuring that federally funded research is transparent, rigorous, and impactful, and that federal decisions are informed by the most credible, reliable, and impartial scientific evidence available. As part of the requirements of EO 14303, the Office of Science and Technology Policy (OSTP) published a Memorandum for Agency Guidance for Implementing Gold Standard Science in the Conduct and Management of Scientific Activities[2] on June 23, 2025 (subsequently referred to as the "OSTP Guidance"). The EO and OSTP Guidance require each Agency to submit a report on actions they are taking to implement the OSTP Guidance by August 22, 2025.

Consistent with EO 14303 and the OSTP Guidance, this report outlines the EPA's proactive approach to ensuring that science generated and used by the Agency is transparent, withstands scrutiny, fosters cross disciplinary collaboration, and remains free from bias or undue influence. By adhering to these principles, the EPA aims to foster innovation, support, and advance scientific enterprise and institutions that create and apply scientific knowledge in service of its mission and statutorily authorized work and ensure that the United States continues to be a global leader in rigorous, evidence-based science.

EPA Administrator Lee Zeldin's focus for the EPA is on the "Powering the Great American Comeback Initiative"[3] with five pillars to guide the Agency's work: 1) Clean Air, Land, and Water for Every American; 2) Restore American Energy Dominance; 3) Permitting Reform, Cooperative Federalism, and Cross-Agency Partnership; 4) Make the United States the Artificial Intelligence Capital of the World; and 5) Protecting and Bringing Back American Auto Jobs. The EPA is committed to upholding the principles of Gold Standard Science, which support all five pillars of this initiative, to ensure that the Agency's decisions and policies are informed by the most credible, reliable, and impartial scientific evidence available.

[1] https://www.federalregister.gov/documents/2025/05/29/2025-09802/restoring-gold-standard-science
[2] https://www.whitehouse.gov/wp-content/uploads/2025/03/OSTP-Guidance-for-GSS-June-2025.pdf
[3] https://www.epa.gov/newsreleases/epa-administrator-lee-zeldin-announces-epas-powering-great-american-comeback

This report outlines the EPA's proactive approach to ensuring that science generated and used by the Agency is transparent, withstands scrutiny, fosters cross disciplinary collaboration, and is free from bias or undue influence in the following sections:

I. ***Ensuring EPA Adherence to the Tenets of Gold Standard Science*** – EO 14303 defines Gold Standard Science as science conducted in a manner that is: reproducible, transparent, communicative of error and uncertainty, collaborative and interdisciplinary, skeptical of its findings and assumptions, structured for falsifiability of hypotheses, subject to unbiased peer review, accepting of negative results as positive outcomes, and without conflicts of interest.

II. ***Development of Standardized Metrics and Evaluation Mechanisms*** – The EPA will work to identify meaningful and measurable standardized metrics and evaluation procedures to track implementation and determine the effectiveness of the processes the EPA uses to foster and implement the tenets of Gold Standard Science.

III. ***Providing Training and Resources to EPA Personnel*** – The EPA has prioritized fostering a culture of science and research that celebrates and maximizes the tenets of Gold Standard Science, and a key activity underpinning and supporting this culture is a focus on a robust program of training and the availability of adequate resources for staff and managers.

IV. ***Leveraging Technology for Implementation*** – The EPA has prioritized the development and integration of technology to promote robust scientific practices that can be easily applied to meet the expectations of the tenets of Gold Standard Science.

V. ***Challenges to Implementation*** – The EPA is committed to the full and transparent implementation of the tenets of Gold Standard Science and will carefully monitor this implementation and education of the workforce going forward to identify and document any challenges encountered.

Each tenet impacts and relies on the efforts made related to the other tenets. Where applicable, this report also addresses how the tenets are reflected in extramural research funding opportunities, award selection and reporting, and budget and other resource allocations. By adhering to these principles, the EPA aims to foster innovation, advance the application of scientific knowledge in service of its mission, meet our statutory obligations while bolstering both environmental protection and economic prosperity, and ensure that the United States continues to be a global leader in rigorous, evidence-based science.

I. Ensuring EPA Adherence to the Tenets of Gold Standard Science

EO 14303 defines Gold Standard Science as science conducted in a manner that is: reproducible, transparent, communicative of error and uncertainty, collaborative and interdisciplinary, skeptical of its findings and assumptions, structured for falsifiability of hypotheses, subject to unbiased peer review, accepting of negative results as positive outcomes, and without conflicts of interest. Selected examples of the EPA's adherence to each tenet are explained below.

Reproducible – *Reproducibility in science is the ability of independent researchers to test a hypothesis through multiple methods and consistently achieve results that confirm or refute it, ensuring findings are generalizable and robust across different approaches. Replicability is the ability to perform the same experiment or study using the same methods and conditions to achieve the same result. Both are essential pillars of the scientific method: replicability ensures the integrity and precision of specific experiments, while reproducibility validates broader*

scientific claims. These concepts are fundamental to the scientific method, ensuring that findings are sound and verifiable, and not due to chance, bias, or error. (OSTP Guidance, p. 2)

Reproducibility is a principal element of the EPA's culture and is an important goal for all scientific activities, particularly for science supporting regulatory analysis. The EPA strives to provide data, code, models, and adequate documentation of key parameters and assumptions to allow the public to understand and reproduce analytic results. Providing these materials also allows the public to explore the implications of alternative assumptions when providing comment on regulatory options.

Understanding the quality of scientific information is critical for reproducibility and replicability. The EPA invests substantial efforts in providing oversight and requirements for quality management activities at the Agency through the EPA's Quality Program[4] and the Quality Program Directives.[5] The EPA Quality Program promotes research reproducibility by establishing policies, procedures, and guidance to ensure that environmental data collected, analyzed, and used by the EPA are of sufficient quality to support decision-making. The EPA follows nationally recognized standards and internal policies for laboratory operations, competency, certification and accreditation programs promoting consistency within and between laboratories, thus facilitating reproducibility and replicability. The EPA also prioritizes the use of validated methods in its research that have been subject to rigorous testing and peer review to ensure the accuracy, reliability, and reproducibility of its findings. These methods are proven to produce reliable and consistent results and are often standardized across the Agency. However, the Agency may not exclusively use validated methods in all situations as they may not be available. In areas where validated methods do not exist, the EPA may develop, test, and validate new methodologies. This is particularly relevant in emerging fields or when addressing novel environmental challenges. Regardless of whether methods are newly developed or established, the EPA implements stringent quality assurance/quality control (QA/QC) procedures to ensure data quality and reliability.

Other key aspects of reproducibility that the EPA employs when appropriate include clear and detailed documentation of the research methods, procedures, and protocols used for studies; providing access to raw, processed, and metadata associated with the research; employing appropriate statistical methods and analyses to ensure that studies include sufficient sample sizes for robust results and that results are not due to random chance; writing comprehensive and clear reports that detail the research process, results, and interpretations; subjecting research findings to peer review, where independent experts evaluate the methodology, results, and conclusions; adopting open science practices, such as sharing data, code, and materials, to promote transparency and collaboration within the scientific community; and adhering to ethical standards and guidelines in conducting and reporting research.

The EPA's policies and protocols will guide the Agency's use of high-quality science.

Transparent – *Transparency in science entails the open, accessible, and comprehensive sharing of all components of the research process—methodologies, data, analytical tools, and findings—to enable stringent scrutiny, validation, and reuse by the scientific community and the public. Transparency builds trust, fosters accountability, and promotes collaboration while reducing errors and bias. It complements reproducibility by ensuring that the materials and processes needed to replicate studies are accessible and clearly reported. It requires detailed disclosure of experimental protocols, raw data, software tools, and potential conflicts of interest, facilitated through platforms such as open-access journals, public data repositories, and standardized reporting frameworks. (OSTP Guidance, p. 2)*

[4] https://www.epa.gov/quality

[5] https://www.epa.gov/quality/quality-program-directives

The EPA is committed to making its scientific data, tools, and products publicly available when feasible and consistent with applicable law. The EPA has procedures to promote the transparency of the scientific and economic analyses used to support regulations and prioritizes making its findings available to the public. The Science Inventory[6] is a publicly available searchable database that contains published scientific and technical products used to support an EPA regulatory program, policy position, research program or other Agency position or action. To provide the public with access to EPA-published or EPA-funded peer-reviewed journal articles, the Agency uses the PubMed Central digital repository (PMC).[7] Any EPA-funded intramural or extramural research publication is required to be deposited in the PMC.[8]

The EPA also shares scientific data by working with the data clearinghouse for the federal government, Data.gov,[9] to provide the public access to EPA datasets. Larger data that cannot be shared easily in Data.gov can be retrieved using public repositories[10] such as the Gene Expression Omnibus (GEO).[11] To maximize public access while protecting private information, the EPA has made selected data available in a secure data enclave. To ensure transparency, the EPA's public access procedures and policies note that intramural researchers should develop a scientific data management plan (SDMP) for each research project that generates original data. The SDMP includes where the digital data and metadata will be stored to enable public access. EPA-funded extramural researchers must also develop an SDMP as part of their application.[12] The EPA also transparently shares databases and tools, which enhances the value of the individual research studies by compiling relevant information and making it easier to access. In fact, the EPA Science Models and Research Tools (SMaRT) Search[13] allows the public to search an inventory of models, tools, and databases resulting from EPA research. To increase public access to EPA-funded research, EPA's Plan to Increase Access to Results of EPA-Funded Scientific Research[14] was published on November 29, 2016, and expanded with the August 17, 2023, Update to EPA's Plan to Increase Access to Results of EPA-Funded Scientific Research.[15]

In addition to public access, the EPA is also transparent about the research it funds with respect to peer and merit reviews. EPA Order 5700.5A1, Policy for Competition of Assistance Agreements, details the EPA's policy to promote competition to the maximum extent practicable in the award of assistance agreements.[16] The EPA has also had policy and procedures for its open data standards for many years. For example, in 2007 the Agency finalized its Data Standards Policy (CIO 2133.0)[17] and its Data Standards Implementation Policy (CIO 2133-P-3).[18] These documents establish principles, responsibilities, and requirements for the development, maintenance, and implementation of data standards within the jurisdiction of the EPA. The EPA also has an established data governance body focused on Open Data initiatives, which ensures the public sees transparency, participation, and collaboration from all federal agencies.[19]

[6] https://cfpub.epa.gov/si/
[7] https://pmc.ncbi.nlm.nih.gov/
[8] https://www.epa.gov/data/open-data-policies
[9] https://work.epa.gov/sites/default/files/2023-06/EPA-Funded%20Research%20Publication%20Submissions%20in%20PubMed%20Central%20%28PMC%29%20Implementation%20Plan%2C%20Version%201.pdf
[10] https://www.epa.gov/developers/epa-application-developmenthosting-environments
[11] https://www.ncbi.nlm.nih.gov/geo/
[12] https://www.epa.gov/sites/default/files/2019-09/documents/order_1000_17b.pdf
[13] https://www.epa.gov/research/epa-science-models-and-research-tools-smart-search
[14] https://www.epa.gov/sites/default/files/2016-12/documents/epascientificresearchtransperancyplan.pdf
[15] https://www.epa.gov/system/files/documents/2024-12/update-to-epas-plan-to-increase-access-to-results-of-epa-funded-scientific-research.pdf
[16] https://www.epa.gov/grants/epa-order-57005a1-epas-policy-competition-assistance-agreements
[17] https://www.epa.gov/sites/default/files/2013-11/documents/21330.pdf
[18] https://www.epa.gov/sites/default/files/2013-11/documents/2133p3.pdf
[19] https://www.epa.gov/system/files/documents/2025-07/epa-open-data-plan-2025.pdf

The EPA remains committed to providing complete descriptions and context for our data assets to enhance their value and ensure they are useful for all. The EPA's commitment to transparency will promote the public's trust and confidence in decisions informed by the best available science.

Communicative of Error and Uncertainty – *Communicating error and uncertainty in science entails the clear, precise, and accurate disclosure of limitations, variability, and potential sources of error or limitations in measurements or research findings, enabling other scientists to critically assess, replicate, and extend the work. This practice is essential for advancing scientific discovery, as it upholds the integrity of new knowledge, fosters scrupulous inquiry, and supports collaborative innovation by providing a trustworthy foundation for future research. Effective communication of error and uncertainty requires researchers to quantify statistical uncertainties, document and report potential sources of error, clearly articulate assumptions and methodological limitations, and disclose potential biases. Communication of error and uncertainty can be accomplished by leveraging tools such as comprehensive documentation, statistical metrics, visualizations, and standardized reporting formats. (OSTP Guidance, p. 3)*

Communicating error and uncertainty in research data is a crucial aspect of scientific reporting that enhances transparency, credibility, and the utility of research findings. The quantitative methods the EPA employs to communicate error and uncertainty include using statistical tools to quantify uncertainty and provide a numerical representation of variability and potential error in the data; employing visual tools like error bars on graphs to effectively illustrate the range of uncertainty in data points; conducting and reporting sensitivity analyses to show how changes in assumptions or input variables affect the outcomes to highlight the robustness of the results and identifies key factors contributing to uncertainty; and performing scenario analyses to present multiple scenarios based on different assumptions or conditions. These tools and processes can help stakeholders understand how uncertainty might impact conclusions under various circumstances.

Alongside quantitative measures, the EPA reports qualitative descriptions of uncertainty sources, such as sampling bias or model limitations, to help contextualize the statistical information. Reports clearly describe the methods used to estimate error and uncertainty, including any assumptions or limitations inherent in the approach, allowing others to evaluate the validity of the estimates. Finally, when drawing conclusions, research reports explicitly state the level of confidence in the findings and the potential impact of uncertainty on the interpretation of results. By effectively communicating error and uncertainty, researchers provide a more comprehensive and honest representation of their findings, ultimately enhancing the credibility and utility of scientific research.

Communicating error and uncertainty in the various types of models used in risk assessment is essential to ensure transparency, support informed decision-making, and maintain trust. It is necessary to clearly describe the sources of uncertainty, and the assumptions used to better understand how they would affect the confidence in the results and ultimately in any regulation or risk management action.

The EPA has policies and guidelines that emphasize the importance of reporting measurement uncertainty, particularly as part of its broader commitment to quality assurance. By integrating measurement uncertainty into its quality assurance practices, the EPA aims to enhance the transparency, reliability, and credibility of its research findings.

These quantitative and qualitative methods underlie the EPA's dedication to fostering trust in the Agency's science.

Collaborative and Interdisciplinary – *Collaborative and interdisciplinary science refers to the strategic integration of a wide range of expertise, methodologies, and perspectives across disciplines and sectors to address complex scientific challenges and catalyze transformative discoveries. This approach is vital for generating new knowledge,*

as it fosters synergy, leverages complementary skills, and promotes the synthesis of ideas to raise new questions and tackle multifaceted problems that transcend traditional disciplinary boundaries. Effective collaboration and interdisciplinarity require open communication, shared resources, and inclusive frameworks, often supported by joint research initiatives, interoperable data-sharing platforms, cross-disciplinary training programs, and development of shared terminology. (OSTP Guidance, p. 3,4)

The EPA's mission to protect human health and the environment often requires a collaborative and interdisciplinary approach. The EPA has a long history of proactively working collaboratively across individuals, divisions, offices, agencies, and institutions.

The EPA has a variety of ways to engage across the Agency to address potential cross-disciplinary challenges. For example, the EPA's Science and Technology Policy Council (STPC)[20] is a cross-Agency decision-making body made up of senior EPA career leadership, supported by a panel of senior scientists, that oversees priority science and technology policy topics that help advance the Agency's environmental and human health mission. The Agency also has a history of developing topic-specific cross-Agency groups, when appropriate. Examples include the Senior Lead (Pb) Leadership Coordinating Committee that brings together program and regional offices to achieve the goals under the 2018 Federal Lead Action Plan and the cross-Agency PFAS group.

Additionally, across governmental agencies, the EPA participates in several partnerships and the EPA also fosters partnerships external to the federal family with States and Tribes to ensure collaboration and interdisciplinary work to address priority environmental challenges. The EPA also engages in established programs to facilitate collaboration between industry, NGOs, academia, and federal sponsors to advance innovative solutions to environmental problems. The Agency has authority under the Federal Technology Transfer Act Program[21] to collaborate with outside entities on developing solutions to environmental problems while providing economic incentive to partners in business, academia, trade associations, and more. Finally, the EPA also participates in international partnership to support U.S. engagement and leadership abroad.

Moving forward, the EPA will leverage these tools and partnerships to prioritize collaborative and interdisciplinary approaches in scientific research.

Skeptical of its Findings and Assumptions – *Maintaining constructive skepticism of findings and assumptions in science refers to the critical and open-minded evaluation of research findings, methodologies, and underlying assumptions to ensure their validity, robustness, and reliability. This approach is essential for generating reliable new knowledge, as it encourages scientists to challenge conclusions, explore alternative hypotheses, and identify potential biases or errors, thereby strengthening the scientific process. Effective skepticism requires researchers to employ robust validation methods—such as peer and merit review, replication studies, sensitivity analyses, and uncertainty assessments—while cultivating an open mindset that embraces scrutiny, iterative refinement, and intellectual humility. A key component of constructive skepticism is actively avoiding confirmation bias—the tendency to favor evidence that supports pre-existing beliefs or hypotheses while dismissing contradictory data (OSTP Guidance, p.4)*

The EPA is committed to maintaining and promoting a workplace where scientists are empowered to think critically about the data in front of them, and consider all possible explanations, without bias, that could account for the effects being observed. Central to thinking critically about an array of scientific information is to promote a culture of constructive skepticism amongst the staff conducting, reviewing, and applying scientific analyses. Constructive skepticism involves transparently evaluating competing hypotheses, rigorously evaluating the evidence behind a

[20] https://www.epa.gov/scientific-leadership/about-scientific-leadership
[21] https://www.epa.gov/ftta

hypothesis (and coming to a conclusion on the strength of that evidence), and being open to data that may challenge the prevailing hypothesis. Scientific information is more robust, independent, and high-quality when it is evaluated from an appropriately critical and objective perspective. EPA embraces a culture of constructive skepticism and welcomes vigorous internal debate of differing scientific points of view in all aspects of the scientific process. The EPA's Scientific Integrity Policy (2012)[22] states that robust, independent, and high-quality science should inform agency decisionmaking, consistent with the Agency's statutory authority.

Staff reviewing scientific information at the EPA routinely employ analytical methods like sensitivity analyses and quantitative uncertainty analyses to critically assess the validity of research results. When there is debate as to the quality, relevance, or interpretation of the data underlying the Agency's decisions, there are processes, and forums, in place to ensure those issues are brought to the attention of and discussed within the senior Agency leadership.

A method of addressing internal debates on scientific issues is a broader peer review process and external peer review[23] is a common method of seeking broader input from independent experts to interpret challenging scientific information. Peer review promotes scientific skepticism by exposing the Agency's analyses and conclusions to scrutiny by scientific experts with varied perspectives, prior to finalizing a work product. The more the conclusions in a scientific document can withstand independent scientific scrutiny, the more confidence the Agency and the public can have in its conclusions.

Lastly, since the enactment of the Foundations for Evidence-Based Policymaking Act (Evidence Act)[24] in 2019, the EPA has been advancing the use of statistical methods within the Agency to ensure that appropriate quantitative rigor is applied to the data that inform the Agency's decisions.

Ensuring these standards are adhered to will increase confidence that the data informing the Agency's decisions are critically reviewed and considered before use.

Structured for Falsifiability of Hypotheses – *Structuring science for falsifiability of hypotheses entails designing research studies and experiments to enable hypotheses to be carefully tested and potentially disproven through empirical evidence. This approach is essential for generating new knowledge, as it anchors scientific claims in testable, refutable predictions—promoting rigor and preventing the perpetuation of unverified assumptions. Effective falsifiability requires researchers to formulate precise, testable hypotheses, design experiments with measurable outcomes, and employ rigorous methodologies—such as controlled experiments, randomized trials, or advanced statistical tests—to systematically challenge predictions. (OSTP Guidance, p. 4, 5)*

Use of the best available science is an important component in decisions informed by science at the EPA. Conclusions derived from rigorous, empirical research that is guided by discrete, testable hypotheses provide insight to the subject matter of their analysis. Scientists at the EPA have significant expertise in using the scientific method and applying appropriate qualitative and quantitative methods to discern and interpret complex, and sometimes conflicting, sources of data and information. Scientific and economic theory and structural models may also provide useful guardrails for formulating and testing hypotheses. Theory can also play an important role when interpreting results. Recognizing the importance of hypothesis-driven research to advancing science, the EPA has relied on significant hypothesis-driven components of its existing research activities to address complex human health and environmental challenges and ultimately inform policy decisions.

[22] https://www.epa.gov/scientific-integrity/epas-scientific-integrity-policy
[23] https://www.epa.gov/scientific-leadership/peer-review
[24] https://www.epa.gov/evaluate/evidence-act

In addition to the regular conduct of scientific inquiry within the Agency, the EPA recognizes the value of hypothesis-driven research as an organizing principle for larger initiatives. For years, the EPA has championed the advancement of computational methods in toxicology and the exposure sciences to transform its approach to human health and ecological risk assessment. More broadly, the EPA is advancing the use of New Approach Methods (NAMs)[25] to reduce the use of vertebrate animal testing while continuing to protect human health and the environment. In prioritizing *in vitro* and computational methods, the EPA is expanding the space in which hypothesis-based testing and methods can be applied. As scientists use these NAMs methods to build a more complete picture of the mechanisms underlying exposure and toxicity of a chemical, they can refine or pose new hypotheses of how a chemical, or groups of chemicals may affect human health and the environment.

Lastly, the EPA maintains several other activities consistent with and supporting the use of hypothesis-driven approaches to inform Agency decisions. The EPA has a strong Data Standards Policy which establishes requirements for the development, maintenance, and implementation of data standards within the EPA.[26] Establishing robust data standards within the EPA promotes data access and the ability to test the validity of hypotheses and potential assumptions made by an analytical team. With this background, the Agency is well-poised to consider hypothesis-driven approaches to inform its decisions.

The EPA will continue to utilize and develop policies and procedures to ensure that scientific research activities are structured for falsifiability of hypotheses.

Subject to Unbiased Peer Review – *Subjecting science to unbiased peer review (sometimes referred to as merit review) refers to the impartial and independent evaluation, by qualified experts, of both research proposals and manuscripts that report results of federally-supported research, to ensure validity, quality, and credibility prior to funding, publication, or dissemination. This process is critical for generating trustworthy new knowledge that minimizes bias, ensures methodological rigor, and upholds scientific standards through objective scrutiny. Effective unbiased peer review relies on transparent, well-defined review criteria, competent and independent reviewers, and robust mechanisms to minimize conflicts of interest, often facilitated by double-blind or open peer review by qualified experts. (OSTP Guidance, p. 5)*

The EPA issued its formal Peer Review Policy in 1993 and the first EPA Peer Review Handbook in 1998. Peer-reviewed data is often used by the Agency to inform many of its decisions and actions. Peer review is the evaluation of a product by experts in the field who were not involved in that product's development. It is an important step in improving the quality of scientific and technical work at the Agency. Peer review is conducted internally and externally for EPA-produced research and EPA-funded research. The EPA's current Peer Review Policy (2006)[27] lays out expectations for the Agency staff in using peer review for their scientific and technical work. To promote consistent, thorough peer review, the EPA developed the Peer Review Handbook (4th Edition)[28] that provides direction on review process throughout the Agency for a variety of products. This how-to manual serves as a single, centralized source of implementation guidance on peer review practices for the EPA staff and managers. In addition, the EPA's Scientific Integrity Policy (2012)[29] calls for following peer review policies and procedures to ensure the accuracy of scientific products.

[25] https://www.epa.gov/chemical-research/epa-new-approach-methods-efforts-reduce-use-vertebrate-animals-chemical-testing
[26] https://www.epa.gov/irmpoli8/policy-and-procedures-epas-data-standards#development
[27] https://www.epa.gov/sites/default/files/2015-01/documents/peer_review_policy_and_memo.pdf
[28] https://www.epa.gov/scientific-leadership/peer-review-handbook-4th-edition-2015
[29] https://www.epa.gov/scientific-integrity/epas-scientific-integrity-policy

The EPA also has groups of external scientists who provide scientific advice to the Agency or Administrator. These committees[30] address charge questions posed by the Agency, ask questions, and provide recommendations for the Agency's use, based on their expertise. The EPA also engages in internal technical review prior to external peer review. This additional step provides early input by technical experts on scientific products. This step is required by some parts of the EPA, for example, those that conduct research. To foster transparency and to meet requirements outlined in the OMB Final Information Quality Bulletin for Peer Review[31], the EPA publishes a Peer Review Agenda[32] that includes all planned and ongoing peer reviews of "influential scientific information" and "highly influential scientific assessment[s]" subject to the bulletin's peer review requirements. The EPA also provides an annual peer review report listing the peer reviews completed each fiscal year. In addition to peer review requirements for EPA-produced products, proposals for EPA-funded extramural research may undergo peer review, if appropriate. Grant proposals are selected based on merit, determined through a fair and objective evaluation, to receive funding, based on the budget availability, and other available resources.[33]

The EPA also has forums to foster ongoing discussion, broaden understanding and support consistent implementation of peer review policy and practices across the Agency, and update the EPA's Peer Review Handbook as needed. The EPA's use of peer review has been, and continues to be, a critical part to the development and use of Gold Standard Science at the Agency.

Accepting of Negative Results as Positive Outcomes – *Accepting negative results as positive outcomes in science refers to recognizing and valuing—as meaningful contributions to knowledge generation—null or unexpected findings that fail to support a hypothesis. This approach is essential for advancing pioneering science, as it counters publication bias, encourages comprehensive reporting, and provides valuable insights into ineffective approaches, thereby guiding future research directions and avoiding redundant efforts. Embracing negative results requires researchers to transparently document and share null findings using accepted methodologies, clear reporting formats, and accessible platforms, such as open-access journals or data repositories. (OSTP Guidance, p. 5, 6)*

The scientific community has acknowledged that there are challenges to the reporting of negative results that are incumbent in the existing publication model. Publication bias in peer-reviewed scientific literature leads to the selection and publication of studies with statistically significant positive findings while studies with either neutral or negative findings are frequently rejected. Negative results, however, are still informative to the larger scientific discourse on a topic, and to weight of evidence conclusions the Agency may make about the strength of science supporting a decision. The challenge facing the Agency is that if the EPA is to rely on the best available science to inform our decisions, the Agency benefits from access to the totality of data and the ability to integrate all relevant evidence to come to the most informed conclusion about the underlying science.

The staff at the EPA who develop scientific analyses released by the Agency are familiar with the challenges in integrating and presenting data with different outcomes. Scientists routinely evaluate the quality of studies and scrutinize the methods employed for technical issues that could result in misinterpretation of the data. They recognize the need to capture and report the totality of quality studies (reflecting both positive and negative outcomes) to evaluate the reproducibility of a chemical effect.

[30] https://www.epa.gov/faca/federal-advisory-committees-epa
[31] https://www.epa.gov/scientific-leadership/office-management-and-budgets-final-information-quality-bulletin-peer-review
[32] https://cfpub.epa.gov/si/si_public_pr_agenda.cfm
[33] https://www.epa.gov/grants/epa-order-57005a1-epas-policy-competition-assistance-agreements

Another area where the EPA recognizes the importance and impact of negative results, consistent with the principles set forth in EO 14303, is in early-stage scientific exploration. At this stage, negative results are arguably just as important as those that would affirm hypotheses because they narrow the scope of the scientific inquiry, encouraging researchers to refine their hypotheses and highlighting areas where more research is needed. They also promote focusing resources on areas of inquiry most likely to yield positive results.

Taken together, the EPA has multiple approaches to support the evaluation and consideration of negative results. The Agency will recognize such results as part of its commitment and efforts to use the best available science to inform decisions.

Without Conflicts of Interest – *Conducting science without conflicts of interest refers to ensuring that research is designed, executed, reviewed, and reported free from financial, personal, or institutional influences that could bias outcomes or undermine objectivity. This approach is important for generating trustworthy and credible new knowledge, as it upholds scientific integrity, fosters public confidence, and ensures that results reflect evidence rather than external agendas. Maintaining freedom from conflicts of interest requires researchers, reviewers, and managers to disclose all relevant affiliations, funding sources, and relationships relevant to the science conducted, adhering to stringent ethical standards supported by strong institutional oversight, transparent reporting systems, and independent expert review mechanisms. (OSTP Guidance, p. 6)*

The EPA has a variety of mechanisms in place to review, address, and disclose potential conflicts of interest (COI) to increase objectivity within science. Conducting science without COI also connects directly to the tenets of reproducibility and transparency. First, it is the obligation and responsibility of all federal employees to abide by the federal ethics rules. Among these rules include the criminal financial conflict of interest statute, 18 U.S.C. § 208,[34] and the Standards of Ethical Conduct for Employees of the Executive Branch, 5 C.F.R. 2635, including the Impartiality Standards at Subpart E.[35] In addition, the EPA has its own supplemental ethics regulation at 5 C.F.R. Part 6401, the Supplemental Standards of Ethical Conduct for Employees of the Environmental Protection Agency, which sets out prohibited financial interests for certain EPA offices at 5 C.F.R. 6401.102, as well as prior approval for outside employment activities at 5 C.F.R. 6401.103.[36]

To help inform employees of their ethics obligations, all new employees at the EPA must complete initial ethics training within three months of their appointment. *See* 5 C.F.R. 2638.304. This initial ethics training covers, at minimum, financial conflicts of interest, impartiality, misuse of position, and gifts.

Additionally, some employees at the EPA file financial disclosure reports, depending on if the employee meets the definition of a confidential filer as set forth at 5 C.F.R. 2634, Subpart I[37] or a public filer, as set forth at 5 C.F.R. 2634, Subpart B.[38] The confidential and public financial disclosure reports help ethics officials at the EPA to educate employees about their specific ethics obligations. All financial disclosure report filers, whether confidential or public, are required to complete annual ethics training each year that covers, at minimum, financial conflicts of interest, impartiality, misuse of position, and gifts. *See* 5 C.F.R. 2638.307-308.[39] Those employees who do not file financial disclosure reports are always encouraged to speak with their office's ethics official to address any specific ethics concerns they might have.

[34] https://www.govinfo.gov/content/pkg/USCODE-2010-title18/html/USCODE-2010-title18-partI-chap11-sec208.htm
[35] https://www.ecfr.gov/current/title-5/chapter-XVI/subchapter-B/part-2635
[36] https://www.ecfr.gov/current/title-5/chapter-LIV/part-6401
[37] https://www.ecfr.gov/current/title-5/chapter-XVI/subchapter-B/part-2634/subpart-I
[38] https://www.ecfr.gov/current/title-5/chapter-XVI/subchapter-B/part-2634/subpart-B
[39] https://www.ecfr.gov/current/title-5/chapter-XVI/subchapter-B/part-2638

The EPA's Deputy and Assistant Ethics Officials reside across the EPA's program and regional offices and are the first point of contact for employees who have questions about their ethics obligations Employees and ethics officials may also reach out directly to the EPA's Ethics Office[40] with any ethics questions that they have. The EPA Ethics Program maintains a variety of ethics resources on its internal website, including job aides for ethics officials.

The EPA's Peer Review Handbook notes best practices for managing peer review and conflicts of interests, including reviewers not being associated with the work reviewed, and to "disclose any activities or circumstances that could pose a conflict of interest or create an appearance of a loss of impartiality that could interfere with an objective review."[41] Depending on the type of peer review, the Handbook recommends different controls to ensure impartiality of the peer reviewers.

The EPA has many processes and procedures in place to address the nine Gold Standard Science tenets, particularly related to conflicts of interest, and the Agency is committed to stringently enforcing its existing procedures to ensure that scientific research is free from undue influence.

II. Development of Standardized Metrics and Evaluation Mechanisms

The EPA has a long history of developing metrics to evaluate its performance and drive continuous improvement. In the Agency's strategic planning process, the EPA often develops long-term performance goals that reflect the quantifiable outcomes the Agency will achieve for its strategic objectives. The EPA also references the OMB Memorandum M-20-12, "Phase 4 Implementation of the Foundations for Evidence-Based Policymaking Act of 2018: Program Evaluation Standards and Practices,"[42] in building evaluation capacity and carrying out evaluations to support evidence-based policymaking. In developing standardized metrics and evaluation mechanisms to assess adherence to the tenets of Gold Standard Science, the EPA will work closely with OSTP.

In doing so, the EPA will work through coordination across the Agency to identify meaningful and measurable standardized metrics and evaluation procedures to track implementation and determine the effectiveness of the processes the EPA uses to foster and implement the tenets of Gold Standard Science. To the extent practicable, the EPA will leverage existing data collection opportunities, such as tracking required trainings relevant to Gold Standard Science and collecting metrics related to compliance with public access policies. The EPA will also explore other existing Agency processes that could potentially be used to collect data. For example, the EPA has a robust history of holding regular business reviews to evaluate progress on key areas of the Agency's work using tools such as bowling charts and visual process management approaches. The EPA will also work collaboratively across the Agency and with OSTP to identify key areas in which useful data and information should be captured and assessed.

The development of metrics both internally and in coordination with OSTP affords the Agency the opportunity to develop these standards and evaluations using existing technology or adopting new and innovative systems to support these efforts and promotes consistency across the federal government

[40] https://www.epa.gov/aboutepa/about-office-general-counsel-ogc#ethics-office
[41] https://www.epa.gov/scientific-leadership/peer-review-handbook-4th-edition-2015
[42] https://www.whitehouse.gov/wp-content/uploads/2020/03/M-20-12.pdf

III. Providing Training and Resources to EPA Personnel

The EPA has prioritized fostering a culture of science and research that celebrates and maximizes the tenets of Gold Standard Science. A key activity underpinning and supporting this culture is a focus on a robust program of training and the availability of adequate resources for staff and managers.

The EPA requires numerous trainings that help advance the tenets of Gold Standard Science. Training on scientific integrity is required for all new EPA employees, and the Agency provides an annual employee meeting focused on scientific integrity to ensure employees are aware of scientific integrity principles and resources. The EPA also requires ethics training for all new employees and requires annual refresher trainings. In addition to these required trainings, the EPA offers trainings on a range of other topics related to the tenets of Gold Standard Science, including periodic trainings related to quality assurance, peer review, public access, and more. In addition to these existing trainings on specific topics, the EPA will identify opportunities to develop trainings on Gold Standard Science and its implementation at the Agency.

The EPA provides extensive resources to assist staff in navigating topics related to Gold Standard Science. For example, the EPA has developed a website dedicated to providing scientific integrity resources to the EPA employees and the public, including links to policies and procedures, outreach and training, scientific integrity survey results, and more.[43] The EPA has also developed an internal, comprehensive resource page to assist Agency employees in identifying and avoiding potential conflicts of interest. In addition, the EPA provides a range of resources on many of the tenets of Gold Standard Science for the EPA staff, including information about differing scientific opinions, peer review, information quality, public access, risk assessment guidelines, and statistics resources. These resources are easily accessible for employees to inform their work and ensure they are upholding the EPA's commitment to these principles. As the EPA develops additional training and resources regarding Gold Standard Science and its implementation, they will be made readily available to all staff to foster the integration of Gold Standard Science in all Agency activities.

The EPA also houses several cross-Agency bodies that foster information sharing and the development of procedures related to science and technology policy. Going forward, the EPA can continue leveraging these groups to ensure a commitment to the tenets of Gold Standard Science, including developing or updating policy and procedures, fostering a culture of Gold Standard Science, and providing training and resources to Agency staff.

IV. Leveraging Technology for Implementation

The EPA has prioritized the development and integration of technology to promote robust scientific practices. As such, the EPA has many existing technological capabilities already in use as part of the Agency's long-standing culture of scientific integrity, transparency, and science leadership that can be easily applied to meet the expectations outlined in the Gold Science Standard EO. These technologies are designed to ensure access, transparency, collaboration, peer review, and reproducibility and replicability. The EPA plans to undertake an evaluation of current technologies to determine how they can further or more broadly support the implementation of Gold Standard Science and the requirements of EO 14303 at the EPA. As the planning and implementation for the future of Gold Standard Science are developed, the EPA will ensure that the use of technology is a key component in fulfilling the mandates directed in EO 14303.

[43] https://www.epa.gov/scientific-integrity

Specifically, the Agency has a goal of leveraging AI to support and enhance its scientific work. The EPA already integrates the use of AI in some of its programs and processes and has developed a set of resources for the Agency employees including trainings, an internal GenAI tool, and an extensive guidance and policy repository. The Agency continues to identify new use case opportunities to leverage AI in its data analyses, synthesis, modeling, and other activities, all of which are captured in a comprehensive inventory.[44] The EPA will continue its commitment by utilizing AI to advance its capabilities to support statutory requirements and the implementation of and compliance with EO 14303. Moving forward, the Agency will include AI tools as appropriate and applicable in its effort to integrate technology in fostering and tracking compliance in deploying Gold Standard Science across the EPA. As noted, AI will be a focus area in the planned technology review to determine the best means to leverage AI in both EPA work and in implementation of Gold Standard Science.

As the EPA leverages new data and technological tools, such as AI, it strives to do so in ways that are consistent with the principles laid out in EO 14303 for Gold Standard Science.

V. Challenges to Implementation

The EPA is committed to the full and transparent implementation of the tenets of Gold Standard Science. The Agency will carefully monitor this implementation and education of the workforce going forward to identify and document any challenges encountered. Some potential challenges that may arise during implementation are outlined below and include operational challenges as well as scientific ones.

As the Agency identifies opportunities to develop and incorporate new technologies, including AI, there may be a need to examine ways to expedite technology incorporation. This process can sometimes be cumbersome and have lengthy timelines, especially with respect to new technologies. The EPA will continue to work internally and across the federal government to identify opportunities to streamline and make the technology acquisition and implementation processes more efficient.

Randomized experimental study designs are often considered the most rigorous methods for determining causal inference. However, it is difficult to design experiments that are both controlled and reflective of the real-world environment due to ethical, legal, financial, and other constraints. The EPA has developed mechanisms to address this challenge, such as conducting experiments at different scales. However, these types of scalable projects can raise concerns about external validity, which introduces uncertainty when applying the results in other situations.

The EPA strives to use the most rigorous and precise methods possible for its scientific evaluations, including occasions where randomized experiments in real-world conditions are not the most appropriate approach or are impossible.

To help address these types of challenges, the EPA has created a new Office of Applied Science and Environmental Solutions, elevated into the Office of the Administrator, which will allow EPA to align research and put science at the forefront of rulemakings and technical assistance and ensure more effective collaboration and solutions. This work will improve the effectiveness and efficiency of EPA operations and align core statutory requirements with its organizational structure. To fully implement the tenets of Gold Standard Science, the EPA will leverage existing Agency resources and networks to promote and foster a robust understanding of each of the tenets of Gold Standard Science.

[44] https://www.epa.gov/data/ai-use-case-inventory

As the EPA moves forward, the Agency will carefully identify and analyze challenge areas and raise them for consideration during cross-Agency conversations and in discussions with other federal agencies and OSTP.

VI. Conclusion

As noted in the OSTP Guidance, Gold Standard Science represents a commitment to the highest standards of scientific integrity and is defined by nine core tenets: reproducible, transparent, communicative of error and uncertainty, collaborative and interdisciplinary, skeptical of its findings and assumptions, structured for falsifiability of hypotheses, subject to unbiased peer review, accepting of negative results as positive outcomes, and without conflicts of interest.

As the EPA moves forward, it will ensure that the principles of Gold Standard Science continue to be integrated and championed in all our intramural and extramural work. EPA plans to review relevant existing documents, tools, and programs to identify gaps in implementing Gold Standard Science. Additionally, the EPA will convene discussions with senior leadership to identify any barriers to fully implementing a culture of Gold Standard Science. After gaps and barriers are identified, the EPA will identify opportunities to provide training to the EPA staff and will address where additional or revised guidance is warranted. These actions will help ensure continuous improvement at the EPA in advancing a culture of Gold Standard Science and implementing its nine tenets. Finding opportunities to further advance and implement the key tenets of Gold Standard Science will be an Agency priority, including as the EPA implements additional Executive Orders, and will be included in future reports.

The EPA's important mission to protect human health and the environment is scientifically complex and requires multidisciplinary and collaborative approaches. The EPA is committed to building on its past approaches related to the tenets of Gold Standard Science to further advance these important principles that ensure that the EPA's science is transparent, rigorous, reliable, and impartial. In doing so, the EPA's scientific endeavors will be best positioned to deliver impactful results for the American people.