

**Biological and Environmental Research Advisory Committee
(BERAC) Meeting Minutes
October 24 - 25, 2024**

**Hybrid In-person / Zoom Meeting at Bethesda North Marriott Hotel & Conference Center
Rockville, MD**

BERAC Members Present

Bruce Hungate, Chair

Cris Argueso

Michael Bellamy

Edgar Cahoon

Romy Chakraborty

Sen Chiao

Emanuale DiLorenzo

Leo Donner

Matthew Fields

Robert Fischetti

Ann Fridland

Jorge Gonzalez-Cruz

Theodore Goodson, III

Randi Johnson

Kerstin Kleese van Dam

Petra Klein

Xiaohong Liu

Diane Lidke

Maureen McCann

Gloria Muday

Dev Niyogi

Himadri Pakrasi

Kristala Jones Prather

Patrick Reed

Gemma Reguera

Jeremy Schmutz

Karen Seto

Matthew Shupe

Rodrigo Vargas

Guest Speakers

Beth Drewniak

Hendrik Hamman

Shaima Nasiri

Christine Negri

Paola Passalacqua

David Sailor

Libby White

Ben Zaitchik

Designated Federal Officer

Dorothy Koch

Approximately 130 additional people were in attendance for all or part of the meeting.

All presentations are posted to the BERAC website: <https://science.osti.gov/ber/berac/Meetings>

Thursday, October 24, 2024

Welcome

BERAC Chair, Bruce Hungate, called the meeting to order at 9:00 a.m. Eastern Time and welcomed attendees.

DOE Office of Science (SC) Update – Dr. Harriet Kung, Acting Director [Presentation posted]

Discussion

An attendee commended SC's plans to upgrade infrastructure at national laboratories and its facilitation of access to users and noted research for the recent Nobel Prize in Chemistry involved several of the laboratories. **Kung** added SC light sources also played a role in the development of the COVID-19 vaccine and sought input on communicating the critical roles played by the SC community and resources.

In response to an inquiry on the new budget's effect on the Energy Earthshot Research Centers (EERCs) and Science Foundations for the Energy Earthshots, **Kung** explained SC's commitment to EERCs and Science Foundations has not waned. Both initiatives will remain as priority items in FY25 budgets. Long-term plans involve integrating Energy Earthshot goals into SC's basic portfolio.

A member asked if the areas of research requiring higher levels of security and scrutiny would be disproportionately burdened by new policies. **Kung** explained optimal operation levels will require iterative feedback and discussion between subject matter experts (SMEs) and The Office of Research, Technology and Economic Security (RTES Office).

An attendee proposed a simplified version of the color-coded Science and Technology (S&T) risk matrix for BER, in which research suitable for open-science journals is automatically considered a low security risk. In addition, comments on budgetary support for cross disciplinary collaborations and exploratory rapid response grants were requested. **Kung** noted all SC research seeks publications. While important, publications cannot hinder due-diligence reviews. Categorical risk assessment could be implemented for financial assistance applications. Seed grants may be a mechanism to fund rapid-response projects. Pending further discussion, the funding may be accessible to all SC programs in 2025.

An attendee solicited Kung's opinion on the current and future levels of research restriction planned for SC. **Kung** commented the national laboratories have progressed on security issues. Clarity, consistency, and transparency are key for consistent and effective policies. University research grants require further development and transparency. Once the community understands what DOE considers high-risk, universities can comply accordingly.

Insight was sought on navigating public-private partnerships (PPP) involving artificial intelligence (AI) which interface national laboratories, academia, and private companies with large datasets. **Kung** noted the topic is complex. PPPs will require input from other organizations, such as the Department of Commerce, which is leading the AI Safety Institute and developing safeguarding policies. DOE is working with the Office of General Counsel to protect derivative products. Understanding SC's funding is limited, DOE's ability to provide checks and balances to industrial development and protect the public is imperative.

BERAC Roundtable

Hungate invited all BERAC members to share advice relevant to the Biological and Environmental Research (BER) program. Major discussion themes involved plant science, artificial intelligence / machine learning (ML), cloud science, and responses to pre-distributed conversational prompts. Many members advised DOE to increase interagency collaboration.

The Grand Challenges for Biological and Environmental Research: Progress and Future Vision Report of 2017 defined new areas worthy of scientific focus and research. Members were encouraged to consider the next round of grand challenge activities. What are the grand contemporary challenges of the changing world? Thinking on the order of a few years, members should consider ways the community can move forward to meet those challenges.

Plant science:

- Plants have complex signaling systems, which reflect environmental conditions and predation. A prevalent area of research aims to isolate and study plant signals to determine how the signals are perceived, integrated, and acted upon to by other plants. BER should consider plant signal integration studies, as these studies are likely to translate into applications relevant to climate change.
- A grand scientific challenge exists in identifying and evaluating the mechanisms and potential trade-offs of plant plasticity. Efforts should aim to design a framework which tracks and predicts populations' evolutionary paths. Research into plant plasticity could lead to the engineering of climate resilient genotypes, which would mitigate some effects of climate change.
- DOE should support a plant transformation facility in association with the national laboratories. The facility would significantly advance plant biology science both in terms of energy crop production and in engineering climate resilient plant genetics.
- A member advocated for more fundamental research into the functions of plants and synthetic plant biology for crop improvement. Plant translations typically employ model species, but using crop species will result in more accurate data.
- BER is the only federal funding agency structured to engage in both genomics and climate research. Thus, a unique opportunity exists to research the bioeconomy using climate-responsive approaches. During the upcoming decade, BER should take the initiative in using plants for bioproduction, plant transformation, and synergistic studies with soil microbe biomes.
- The importance of transitioning away from fossil fuels is gaining widespread recognition. BER is urged to coordinate intra- and interagency efforts to deploy low carbon impact crop systems and transition to a bio-based economy.

AI / ML:

- BER's use of computing technology continues to suffer grand challenges. The Frontiers in Artificial Intelligence for Science, Security and Technology (FASST) initiative holds potential for addressing challenges, enabling science, and increasing competitiveness. Among many opportunities for facilitation, AI could facilitate data integration. BER should consider how AI could both transform the science of the future and tackle new challenges.
- Recent efforts at Howard University involve the application of ML to Earth and environment research, with a focus on precipitation and complex terrain. A convolutional

neural network calculates quantitative precision estimates. The work is facilitated by DOE high performance computing (HPC) facilities.

- DOE's vision of governance, safeguards, and ethics for the AI field emphasizes how communication is a key component in the process of science.
- Modeling systems should better reflect real-world data. Cycles of extremes are more relevant than single events. Cascades and compounding effects require additional attention. In addition, the risks of AI must be considered.
- The use of AI and Quantum Information Sciences (QIS) in environmental and plant processes research was commended. The need for added security and scrutiny in the AI field should not impede DOE's application of the technology and receptivity to new ideas.
- Foundational knowledge underpins advanced tools such as simulation models and AI / ML. Solutions for contemporary scientific problems require simultaneous investment in basic research and accelerating tools.
- There is an opportunity to define DOE's role in developing a foundational AI climate model. The model would address issues such as climate's impact on society and the development of climate resilience strategies in terms of national security. To allow for data transparency, development efforts should be hosted at universities or national laboratories rather than the private sector. Efforts to remove carbon dioxide (CO₂) from the atmosphere, such as marine capture research, would benefit from a platform that enables sustained collaboration on grand scientific challenges.
- DOE's reengagement with the radiation and dosimetry community was commended, as it will enable the integration of genomic and AI / ML techniques in low-dose radiation research.

Cloud science:

- The role of clouds in the atmosphere, biosphere, and weather should be further researched. Research at the Bankhead National Forest (BNF) in Alabama measures air quality through the Atmospheric Radiation Measurement (ARM) user facility's third ARM Mobile Facility (AMF3). Representation of aerosol formation and the subsequent effects on clouds must be improved in climate models to predict extreme weather and protect public health.
- ARM's Cloud and Precipitation Measurements and Science Group recently discussed using the group's measurements to increase accuracy in climate and Earth system models (ESMs). The BER portfolio is rich in cloud and precipitation processes, and BER should consider how data are represented in models.
- A recent DOE Atmospheric System Research (ASR) workshop highlighted major deficiencies in the understanding of ice processes. The workshop's report could serve as the first steps in BER and DOE taking leadership roles in facilitating a better understanding of the processes, building required facilities, and influencing the resulting data's representation in models.

New centers, upgrades, initiatives, and related efforts:

- Replacement of the Advanced Photon Source's (APS) storage ring at Argonne National Laboratory (ANL) has been progressing successfully. Beam current is at 2/3 strength, X-ray intensity is at full levels, and the ring's emittance has established a new

world record. Improved beam brightness will enable new science, and projects previously deferred due to beam limitations will be revisited. The APS shutdown affected half of the beamlines in the U.S., and gratitude was expressed for the other light sources which accommodated ANL's users. Work done by the Empowering Discovery in Biological and Environmental Research (eBERlight) program was commended.

- The effect of relevant urban processes and evolving cities on the coastal environment is a crucial area for BER research. The concept of a new facility, the Coastal Urban Boundary Layer Experimental Facility, has been drafted. Experiments at the facility would focus on environmental science and challenges relevant to urbanization, such as thermal stratification. A second endeavor, in collaboration with the National Institute of Standards and Technology (NIST) and the DOE Office of Energy Efficiency & Renewable Energy (EERE), is exploring the effects of extreme coastal weather on power grids. Testbeds have been deployed in Puerto Rico with instrumentation sensitive to complex terrain.
- Efforts led by The National Academies of Sciences, Engineering, and Medicine (NASEM) seek to identify areas of U.S. – China collaboration. BER should work to facilitate collaborations with China by identifying enabling mechanisms, suitable areas, and any potential roadblocks.
- Results from the DOE-BER National Microbiome Data Collaborative (NMDC) surpassed the scope of funding objectives. The NMDC can serve as a model for other funding agencies interested in microbiome research, data processing, and fair data sharing.

Responses to prompts and other comments:

- DOE was encouraged to collaborate with other government agencies in addressing major challenges in human and environmental health. Current concerns include the overapplication of fertilizers, which leads to nitrate contamination of the well waters used by roughly 50% of the U.S. population and generating the substantial levels of energy required for AI without jeopardizing the environment.
- A member noted the importance of considering perspectives outside the traditional scope of BERAC research. Environmental concerns have far-reaching implications, including allergies and cancer.
- Continued support for urban research was encouraged. Other areas suitable for BER involvement include cascading hazards and AI / ML regulation.
- A grand challenge lies in reducing the time required for transitioning initial concepts to beneficial applications.
- DOE's leadership role in biosphere research was emphasized with three examples: 1. The application of light sources to study interactions between minerals and organic matter; 2. Eddy flux facility efforts to study the exchange of CO₂, water, and methane between landscapes and atmosphere; and 3. ESMs which rely on DOE resources. Interest was expressed for the integration of new discoveries with policy management and the private sector.
- A member aimed to ensure unique observational resources, such as ARM, continue to receive support and improvement; guide the integration of data sets into models; learn from the community; and provide opportunities to future scientists.
- BER was advised to leverage its unique role of influence, stemming from program elements which have local to global impact.

- The legacy of Dr. Warren M. Washington, recently deceased, was reflected upon.

Hungate dismissed the meeting for a break at 10:35 a.m. and reconvened at 10:47 a.m.

News from BER – Dr. Dorothy Koch, Associate Director
[Presentation posted]

Discussion

Regarding the exploration of biology for critical minerals, it was inquired whether BER would employ the legacy expertise previously involved in subsurface biogeochemistry research. **Koch** explained the expertise is still present and involved in many programs. The intention is to build support modeling frameworks that integrate biosystems with physical systems.

An inquiry was made on the possibility of collaborating with the DOE Grid Deployment Office (GDO) and deploying experimental testbeds. **Koch** confirmed a GDO collaboration is in progress and noted current modeling systems include grid simulation.

Hungate dismissed the meeting for lunch at 12:02 p.m. and reconvened at 1:15 p.m.

Update on the Earth and Environmental Systems Science Division (EESSD) – Dr. Gary Geernaert, Division Director
[Presentation posted]

Discussion

Thoughts were requested on making ESM data more accessible, and the possibility of building a new facility to enable the application of AI methods across a broad community. **Geernaert** supported both aspects. Details of the relative SC processes are under development.

Rationale for the lack of urban IFLs and Integrated Coastal Modeling Institutions (ICoMs) in the southeast U.S. and the Gulf of Mexico was requested. **Geernaert** explained the distribution primarily reflects the project applications which reviewed favorably, although geographic diversity was a factor. The southeast currently contains Climate Resilience Centers (CRC), and the area may house future Rural Integrated Field Laboratories (IFLs).

Update on the Biological Systems Science Division (BSSD) – Dr. Todd Anderson, Division Director
[Presentation posted]

Discussion

A member asked if a microbiome-based notice of funding opportunity (NOFO) is anticipated. **Anderson** anticipated the NOFO's release in 2025.

Future workshops focusing on biotic interactions was requested. **Anderson** reassured the topic would be represented through The Biopreparedness Research Virtual Environment (BRaVE) program.

Clarification was sought on BSSD's role in AI governance and safeguards. **Anderson** noted the complexity of the task and added concise, organized, and curated data will be needed to train models and verify results. **Koch** mentioned the DOE is poised to play a leadership role in AI governance due to its expertise in validation, verification, and computing.

State of Urban Climate Research – Dr. Karen Seto, Yale University
[Presentation posted]

Discussion

A member questioned whether the Intergovernmental Panel on Climate Change (IPCC) was accounting for the decarbonization of cities in the Global North. **Seto** confirmed net-zero cities are considered and named Oslo as an example. The IPCC also tracks the method by which cities plan to achieve net-zero status, like Oslo's climate budget.

Insight was sought for actions beyond the presented 2050 timeline, such as the planning process for cities built to last for 200 years. **Seto** explained no considerations extend to 200 years, as most policy makers are interested in immediate action, or items actionable within a 2- to 5-year administration.

Hungate dismissed the meeting for a break at 2:52 p.m. and reconvened at 3:05 p.m.

Urban Integrated Field Lab (IFL) Briefs – Dr. Paola Passalacqua, University of Texas-Austin; Dr. Christine Negri, ANL; Dr. Ben Zaitchik, Johns Hopkins University; and Dr. David Sailor, Arizona State University
[Presentations posted]

Discussion

Interest was expressed in developing a time-dependent metric of resilience that could allow for the establishment of a baseline and provide feedback on experimental solutions. **Zaitchik** noted detailed IFL observations are used for model calibrations, with the goal of developing tools for simulating interventions at a practical scale. **Negri** added the metric is approached through scenario modeling, allowing for the contrast of existing states with one variable element at a time. **Sailor** commented government plans are analyzed with large language models (LLMs) to track the extent to which heat governance is considered. Large-scale decisions which define the city's future will be ill-informed if heat governance is not considered.

BER was advised to fund a follow-up project for IFL data in which BERAC is charged to analyze data across all IFLs and identify relevant mechanisms and urban solutions. **A second member** questioned whether the different approaches used by the IFLs could be coordinated and combined to synthesize lessons learned. **A third member** suggested a NOFO, possibly for graduate students, aimed at analyzing IFL data.

A member recalled the quantification of anthropogenic effects has been shown to reduce model uncertainty by 25% and asked whether similar calculations were considered for the IFLs. **Zaitchik** explained the effects are being considered with flux measurements across different types of urban form in Baltimore. Research has identified the importance of turf grass and vegetative surfaces. In addition, cross cutting projects will coordinate IFLs to examine greenhouse gas flux across different urban environments. The examinations will lead to a common set of metrics applicable to a variety of environments. **Negri** emphasized the importance of vegetation. Gauging the level of representation afforded by flux measurements in cities is currently a challenge.

Workshop Brief: Human Subjects in Energy Technology and Policy Research – Mrs. Libby White, BER

[Presentations posted]

Discussion

Clarification was sought on the unclear and time-consuming process for soliciting grants requiring Institutional Review Board (IRB) approval. **White** agreed the process is complex. At a minimum, solicitations should indicate the participation of human subjects and a need for IRB review. In some instances, awards can be issued before the review. Templates are available, and BER can provide advice on an individual basis.

BERAC Discussion – Dr. Bruce Hungate, BERAC Chair

Hungate encouraged members to share any thoughts on the day's topics, or beyond, in the spirit of giving advice or sharing wisdom.

Additional information was requested for DOE Bioenergy Research Centers (BRCs). **Anderson** noted BRC themes focus on bioeconomy research, which will subsequently identify knowledge gaps. Funding associated with BRC awards will be re-competed at the end of the current five-year cycle. Current efforts in strategic planning and workshops will inform the opportunity's solicitation, to be released one and a half years in advance of the re-compete. **A second member** noted the difficulties facing new researchers in competing against well-established BRC teams in the re-compete and asked if any help will be provided. Without help, the BRCs risk stagnation and exclusion. **Anderson** assured the concern is being accounted for. The process is still under discussion by DOE SC.

A member inquired on the mechanism by which six topics: QIS, AI, HPC, energy storage/batteries, biotechnology, accelerator research and development (R&D) were identified as requiring additional security and precaution. **An attendee** informed the topics are considered emerging technologies and were identified by the White House Office of Science and Technology Policy's (OSTP) National Security team.

Clarification on cross-divisional activities, designated as a BER priority, was requested. **Koch** explained the opportunity to work at the intersection of biology, climate science, and AI is a theme often raised by the community. Additional time is required to determine how the opportunity will manifest in BER.

A question was posed on the possibility of linking wildfire and emission models to the urban environment, and the science needed for accurate representation. **Geernaert** noted simulations would be helpful and will likely be done in the future due to the ASR program's interest in cloud and aerosol chemistry.

A comparison of scope and funding levels for urban and rural IFLs was requested. **Koch** said the budget was not yet finalized.

A member asked for an update on interagency working groups. **Geernaert** explained there are connections to many interagency working groups. The Interagency Group on Integrative Modeling (IGIM) recently discussed priorities for the upcoming Climate Modeling Summit, which included data simulation and air-sea interactions. The Urban Interagency Group (UrbanIG) will have a townhall meeting with the American Geophysical Union (AGU), in which 10 agencies will discuss investments on climate change and evaluate contributions to the IPCC report on cities. **Anderson** mentioned the bioenergy portfolio has strong internal DOE connections. Efforts in plant biology and the BRaVE portfolio involve United States Department

of Agriculture (USDA) programs, and future collaborations with the National Science Foundation (NSF) are likely through the Technology, Innovation and Partnerships (TIP) directorate.

Considering climate modeling efforts, input was sought regarding coordination with the Federal Emergency Management Agency (FEMA). **Geernaert** informed FEMA, a part of the Department of Homeland Security (DHS), regularly attends BER meetings to communicate needs. The National Infrastructure Simulation and Analysis Center (NISAC) is composed of several national laboratories and focuses on projecting region-specific risks, including recovery from extreme weather events.

Hungate dismissed the meeting for the day at 5:30 p.m.

Friday, October 25, 2024

Hungate convened the meeting at 9:00 a.m.

BERAC Science Talk: Supercalifragilistic Advances in Plant Genomics – Mr. Jeremy Schmutz, HudsonAlpha Institute for Biotechnology
[Presentation posted]

Discussion

A member questioned the possibility of using AI to improve Arabidopsis annotations. **Schmutz** commented AI / ML is used for annotation improvement through advanced filtering. Single genome predictions will be combined with multiple representations from the same species and improve all references. AI will also improve annotation consistency.

A member inquired whether advances in plant genomics and structure manipulation could be applied to IFL research, with the aim of correlating structure and heat emissions. **Schmutz** noted urban forestry discussions are focusing on mitigating the pathogen currently destroying urban landscapes and forests. Modeling diverse, robust, and resilient trees would be the first step.

An inquiry was made into the state-of-the-art of predicting a gene's probability of expression. **Schmutz** explained the question is typically avoided. All annotations are evidence based, and a gene's transcription is 99.9% certain.

Insight into generating interest and funding for protein crystallography was requested. **Schmutz** mentioned tens of thousands of plant protein structures are required to improve existing algorithms as the proteins are drastically underrepresented.

Workshop Brief: Southeast Land-Atmosphere Interactions – Dr. Beth Drewniak, BER
[Presentation posted]

Discussion

An attendee questioned whether land-atmosphere couplings were considered. **Drewniak** said couplings pertaining to coastal regions were outside of the workshop's scope.

A.I. and Climate Research – Dr. Hendrik Hamman, International Business Machines (IBM)
[Presentation posted]

Discussion

An attendee asked for insight on data harmonization in the context of training models with various generations of technology. **Hamman** explained data from outdated technologies can be reconstructed through self-supervised approaches.

ML training on fundamental processes, such as microphysics and turbulence, in lieu of traditional data, was proposed as a strategy for enhancing climate models. **Hamman** agreed with the strategy's rationale. A sufficient level of process model data sets and benchmarks would be required, in addition to the ability to discriminate model learning from memorization.

A member inquired on the existence of development guidelines addressing ethics, uncertainty, openness, and security, and asked how data from many models could be combined for analysis. **Hamman** commented the questions are broad and would require more time to fully answer. In general, the foundational models are open source, and following existing processes and forming partnerships are key.

Insight into the application of foundational models to biological emergent properties was requested. **Hamman** stated the models would be applicable in the long-term. However, current architectural systems lack the required capabilities.

An opinion was sought on the merits of extrapolating patterns from global models versus developing more granular regional models. **Hamman** commented larger models require larger attention mechanisms.

A member suggested replacing the discovery process in climate science with AI / ML to identify the physics responsible for uncertainty. **Hamman** stated the suggestion embodies the biggest opportunity for AI.

Hungate dismissed the meeting for a break at 11:01 a.m. and reconvened at 11:15 a.m.

Workshop Brief: Observing Marine Aerosols and Clouds from Ships – Dr. Shaima Nasiri, BER

[Presentation posted]

Discussion

A member asked whether aerosol observations over the Southern Ocean were considered, as additional measurements from the area are needed for climate models. **Nasiri** confirmed the consideration and explained the Southern Ocean is not well traversed by commercial vessels.

BERAC Discussion – Dr. Bruce Hungate, BERAC Chair

Hungate solicited questions, comments, and concerns.

A member commented on the need for additional efforts in determining the structure and function of plant proteins at the atomic level, noted the availability of resources, and questioned the lack of funding for elucidating plant structure and function at BER and other institutions. A **second member** emphasized the need for more investment and understanding in fundamental plant biology. Computational protein predictions could be used to train AI models. **Another member** commented plant laboratories may lack experience with the required tools sets.

A suggestion was made for BER to assume a leadership role in applying existing plant data sets to functional-type climate models.

A member asked whether a roadmap exists for BER's use of AI. **Koch** explained the roadmap is currently under development.

A member suggested the use of ML techniques to identify aspects of climate models which cause the greatest levels of uncertainty. The results would also guide observations. Further, AI can explore tangible interventions and policies for climate risk reduction.

Caution was advised on the improper uses of the term "digital twins". As models become digitally informing, the dynamic and adaptive nature of coupled human-Earth systems must be considered. The implications of risk resilience, decision relevance, privacy, and transparency must be accounted for.

A question was posed on the technology required for facilitating the environmental application of sequencing, enabling the exploration of genotypes and epigenomes in various conditions. It was also noted urban IFLs could be leveraged as a bridge between EESSD and BSSD and evaluate the ecology of the southeast. Finally, it has never been more important for BER to promote and foster trust in science.

A member disagreed with the establishment of isolated, rural IFLs. It would be more interesting to study the continuum from urban to rural, which would elucidate how the communities are linked. Multiple members agreed with the idea of a continuum, and a member suggested the continuum extend to the coast. Another member proposed the collection of cloud and aerosol data from all points in the continuum.

The scientific value of urban IFLs lies in the insight gained on the natural landscape at its point of greatest disruption. IFL's engagement of marginalized groups and societal outreach was commended.

IFLs should engage with policy makers and use data to inform and guide local and regional policies. Precedence exists through EERE's relative funding of laboratories and universities.

A member noted other agencies, such as the USDA, have already made large investments in rural areas. BER should leverage existing resources for rural IFL research through interagency collaboration.

The importance of plant function in addition to structure was emphasized. Insight into gene function and the protein encoded is limited. *The Grand Challenges for Biological and Environmental Research: Progress and Future Vision Report* highlighted the functional annotation of plant genes, and new members are encouraged to read the document.

Excitement was expressed for the scientific leadership, communication, and community development aspects of the BER strategy update.

Public Comment

Dr. Lauren Jabusch of Lawrence Berkeley National Laboratory (LBNL) noted the release of LBNL's *Biosciences 10-year Strategic Plan (2024–2034)*, which includes representation from science, engineering, and operation staff, with early career to senior level participation. Community feedback is requested on the report, which can be found online at <https://biosciences.lbl.gov/strategy/>

Hungate adjourned the meeting at 12:05 p.m.

Respectfully submitted November 15, 2024,
Patrick J. Cosme, Ph.D.
Science Writer, Oak Ridge Institute for Science and Education (ORISE)