



Genesis Mission



U.S. DEPARTMENT
of **ENERGY** | Office of
Science

Summaries of Participant Breakout Sessions

Genesis Mission University/Science Philanthropy Summit

February 18, 2026 | Crystal City, Virginia

Letter from Genesis Mission Director

The United States is entering a pivotal moment in scientific innovation. On Nov. 24, 2025, President Trump issued an Executive Order establishing the Genesis Mission—an ambitious, coordinated national effort designed to *“unleash a new age of AI accelerated innovation and discovery that can solve the most challenging problems of this century.”* The U.S. Department of Energy (DOE), building on its rich legacy of successfully managing complex, large-scale projects and driving scientific advancements across disciplines, leads this transformative endeavor.

We stand at the forefront of a computing revolution. Breakthroughs in high-performance computing, rapid advances in semiconductor technology, and the emergence of powerful artificial intelligence (AI) systems are reshaping how researchers pursue discovery and engineer solutions—both in the United States and across the world.

The Genesis Mission will bring these capabilities together into a groundbreaking scientific instrument: a unified platform that integrates supercomputing, AI, cutting-edge quantum systems, and America’s premier scientific facilities. Its bold objective is to double U.S. research and development productivity over the next decade, compressing timelines for critical discoveries from years to months.

While DOE leads this effort, the success of the Genesis Mission depends fundamentally on the strength and dedication of the broader American scientific community—spanning government, industry, philanthropy, and academia. To bring these diverse capabilities into alignment across the national research and development (R&D) landscape, DOE convened the inaugural Genesis Mission University/Science Philanthropy Summit. This report distills the central themes and insights from that gathering, providing essential guidance for the strategic planning and collaboration required to safeguard America’s energy, economic, and national security.

Dr. Darío Gil
Under Secretary for Science
Genesis Mission Director
U.S. Department of Energy

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Front Matter

Summit Goals

The Genesis Mission University/Science Philanthropy Summit, held Feb. 18, 2026, brought together senior leaders across the U.S. academic and science philanthropy research enterprise to shape a shared vision, strategy, and approach to early Genesis Mission collaboration and partnerships.

More than 400 summit participants discussed opportunities and perceived barriers for universities and science philanthropy to engage the Genesis Mission and charted forward-looking paths for strategic planning and community engagement. The agenda invited each participant to engage in plenary sessions and two facilitated, two-hour breakout sessions, selected from the following topics:

1. **Genesis Mission institutional partnership innovation:** Explore institutional strategies for partnership models to enable research spanning universities, philanthropic organizations, government agencies, and private-sector technology firms to advance artificial intelligence (AI) in science.
2. **Genesis Mission National Science and Technology Challenges:**¹ Explore how universities and science philanthropy see themselves collaborating and what new ideas/approaches/resources they can bring to the first National Challenges in science, national security, and energy missions; gather insights into how institutions identify the most compelling challenges.
3. **Genesis Mission computing and data ecosystem:** Explore a framework to integrate the U.S. Department of Energy (DOE) and university research ecosystems—spanning computing, data, AI models, and experimental and production tools—through institutional-level agreements backed by trust-based relationships, seeded by DOE’s Genesis Mission Trusted Research Environments concept.
4. **Genesis Mission workforce development and engagement:** Assess avenues for rapid collaboration on fellowships, internships, apprenticeships, and other workforce development and early career engagement approaches, emphasizing growing the American workforce.
5. **Genesis Mission research productivity:** Gather perspectives on Genesis Mission value propositions, including metrics of AI-advantage, evaluating productivity in science, career promotion, and incentivizing institution- and individual-level research methods risk-taking.

¹ <https://www.energy.gov/documents/genesis-mission-science-and-technology-challenges>

Breakout Session Methodology

To promote deep engagement and small-group conversations, each breakout session room was limited to 60 participants. The rooms were set up with banquet-style roundtable seating with eight seats per table. Each table had access to a Google Doc for idea capture and notetaking. There were ten rooms in total, with two rooms assigned to each of the five topics above. The morning and afternoon sessions had an identical setup, resulting in four total sessions for each of the five topics. Altogether the participants generated approximately 30 Google Docs for each of the five topics (six to seven tables x four sessions).

The breakout sessions were conducted under not-for-attribution Chatham House Rule.²

Summary Synthesis Methodology

DOE Office of Science staff used Department-approved AI tools³ and human editorial judgment to assemble the summaries presented in this document. The team aimed to preserve the dynamic range of recorded ideas while providing the reader with crisp summaries of each breakout session topic. The team removed the names of individuals and institutions to honor Chatham House Rule principles.

Acknowledgments

Synthesis team

Dr. Jeremy Crampton, Advanced Scientific Computing Research

Dr. Aaron Stone, Basic Energy Sciences

Dr. Marat Valiev, Basic Energy Sciences

Editorial team

Dr. Ben Brown, Advanced Scientific Computing Research

Dr. Gail McLean, Basic Energy Sciences

² <https://www.chathamhouse.org/about-us/chatham-house-rule>

³ <https://joulix.doe.gov/>

Summit Agenda



DOE Genesis Mission University/Science Philanthropy Summit
February 18, 2026
Hyatt Regency Crystal City

<https://www.youtube.com/watch?v=aSVT7P0K0-s>

Agenda

- 7:30 am Registration and Continental Breakfast - Regency Ballroom**
- 8:30 am Welcoming Plenary Session**
Moderated by: Kam Moler, Stanford University
 - 8:35-8:45am DOE senior leadership opening remarks
 - 8:45-9:20am Q&A with Under Secretary Darío Gil
 - 9:20-9:55am Panel Discussion - "How Universities are Advancing AI for Science"
Moderated by: Vice Chancellor Kathy Yelick – UC - Berkeley
Panelist: President Mung Chiang, Purdue University
President Farnam Jahanian, Carnegie Mellon University
President Andrea Goldsmith, Stony Brook University
 - 9:55-10:00am Charge to breakouts
- 10:15 am Break and move to Breakout Session 1**
- 10:30 am Breakout session 1**
 - Institutional Partnership Innovation – *Potomac Room I and II*
 - Lighthouse Challenges – *Potomac Room III and IV*
 - Computing and Data Ecosystem – *Potomac Room V and VI*
 - Workforce Development and Engagement – *Kennedy Room and Jefferson Room*
 - Research Productivity – *Lincoln Room and Roosevelt Room*
- 12:30 pm Lunch - Regency Ballroom**
- 2:00 pm Breakout Session 2**
 - Institutional Partnership Innovation – *Potomac Room I and II*
 - Lighthouse Challenges – *Potomac Room III and IV*
 - Computing and Data Ecosystem – *Potomac Room V and VI*
 - Workforce Development and Engagement – *Kennedy Room and Jefferson Room*
 - Research Productivity – *Lincoln Room and Roosevelt Room*
- 4:00 pm Break and move back to Plenary**
- 4:30 pm Closing Plenary Session - Regency Ballroom**
 - Remarks by Ethan Klein, U.S. Chief Technology Officer, OSTP
 - Brief out from Breakout Sessions - Moderated by Kam Moler
- 5:30 pm End Meeting**

Institutional Partnership Innovation Breakout Sessions

Following is a consolidated summary of the key findings from the discussion on institutional partnership innovation, synthesizing feedback from participant groups.

Overall Summary

The central theme emerging from the discussion was the urgent need to evolve from traditional, siloed research efforts to a more integrated and mission-driven national innovation ecosystem. Participants universally agreed that the primary goal of large-scale partnerships between academia, industry, DOE's National Laboratories, and philanthropy should be to accelerate the translation of foundational research into real-world impact, addressing major societal challenges while fostering economic competitiveness and workforce development.

The most significant obstacles to achieving this goal are not technical, but structural and cultural. Key blockers include misaligned incentives (e.g., academic tenure vs. industry profit), administrative friction in negotiating intellectual property and contracts, and differing operational speeds and risk tolerances. To overcome them, there was consensus on the need for standardized master agreements; clear, upfront goal setting; and a cultural shift within universities to reward team-based, collaborative science.

Effective partnerships are exemplified by projects, such as the Human Genome Project or DARPA-style contests, which unite participants around a clear, ambitious, and compelling vision. These models succeed by creating a focused, competitive, and collaborative environment. Conversely, partnerships fail when they lack genuine integration and clear governance or are formed merely to satisfy funding requirements.

Finally, the discussion highlighted the unique and evolving roles of each partner. Universities offer irreplaceable entrepreneurial energy and high-risk research capabilities, while philanthropy can act as a crucial "risk leader" by funding early-stage, transformative ideas. For this ecosystem to function effectively, participants emphasized the necessity of a new national vision for science and technology and the potential value of trusted intermediary institutions to manage and streamline these complex collaborations.

Summary by Question(s)

Question 1: What are the critical goals that partnerships can address?

Participants agreed that the primary goal of partnerships is to achieve significant, real-world impact at scale, moving beyond purely academic or discovery-oriented science. Achieving this goal involves tackling major societal challenges, fostering economic growth, and developing a skilled workforce. A core objective is to create a trusted, seamless, integrated ecosystem where the unique strengths of academia, industry, National

Laboratories, and philanthropy are mutually recognized and valued to accelerate the entire innovation life cycle, from fundamental research to market-ready solutions.

Participant Feedback:

- **Address Grand Societal Challenges:** Partnerships should focus on large-scale problems of public interest, such as affordability and health, which no single entity can solve alone.
- **Accelerate Innovation:** A key goal is to shorten the time from discovery to market impact by creating more efficient pathways for translation, validation, and commercialization. Academia could help DOE expand impact beyond science, technology, engineering, and mathematics (STEM) into social science, medicine, and the humanities.
- **Workforce Development:** Partnerships must address the need for a skilled workforce by providing students and researchers with cross-sectoral training and experience.
- **Mutual Benefit and Alignment:** For partnerships to succeed, they must be structured to provide clear, mutual benefits for all participants. This requires aligning the diverse incentives that motivate academia (citations, publications), industry (products, monetization), and government (mission-driven outcomes). It requires mutual understanding (e.g., of different incentives) to bridge the “cultural divides.”
- **Data and Resource Sharing:** A critical function of these partnerships is to facilitate the sharing of verified and curated data, tools, and infrastructure, enabling researchers to connect and leverage resources more effectively.

Question 2: What are the blockers of success, and how can we restructure partnerships to overcome them?

The most significant barriers to successful partnerships are misaligned incentives, cultural and operational differences, and administrative friction, particularly concerning intellectual property (IP), data sharing, and contracting. Participants noted a fundamental disconnect in timelines, risk tolerance, and core motivations between academia, industry, and government. To overcome these blockers, there was strong consensus that partnerships require clear, upfront negotiation of expectations, standardized master agreements, and a cultural shift within all institutions to value and reward collaborative, team-based science.

Participant Feedback:

- **Misaligned Incentives and Culture:** A major blocker is the difference in core motivations. Academia’s focus on individual achievement, publications, and tenure often conflicts with industry’s fast-paced, product-driven goals and the mission-centric focus of National Laboratories. This creates a cultural divide, a “human

instinct to protect hard-earned data,” and a lack of incentives for faculty to participate in large-scale, collaborative projects.

- **IP and Data Sharing:** The negotiation of IP rights and data-sharing agreements is consistently cited as one of the most difficult and time-consuming barriers. Concerns over proprietary data, publishing rights, and compliance create significant friction and can stall collaborations before they begin.
- **Administrative and Legal Hurdles:** Administrative red tape is a major challenge, especially at universities—universities can be much too cautious. Slow and complex contracting processes, risk aversion from university legal departments, and a lack of standardized agreements make it difficult to partner efficiently. Participants repeatedly called for templated agreements and a centralized compliance framework to streamline these processes.
- **Differing Timelines and Priorities:** There is a significant mismatch in operational tempo. Academia often operates on yearly or semester-based timelines, while industry works in quarters and demands speed. This “timescale/operational velocity difference” creates friction and misaligned expectations.
- **Lack of Clear Roles and Expectations:** Partnerships often fail when the roles, responsibilities, and desired outcomes for each partner are not clearly defined at the outset. A lack of transparency can lead to misunderstandings and feelings that one partner is bearing an unfair share of the cost or risk. Planning is difficult under conditions of uncertainty (e.g., in funding or priorities).

Question 3: What joint cross-domain projects might benefit from partnerships? What new mechanisms can we engage for these projects?

Participants believe that partnerships are most beneficial for large-scale, complex projects that require interdisciplinary integration and have clear, ambitious goals. The most effective new mechanisms for engagement are structured, competitive challenges modeled after DARPA contests or XPRIZES. These models are seen as powerful tools for inducing focus, fostering rapid ideation, and assembling diverse, mission-aligned teams.

Participant Feedback:

- **National Challenges:** There is strong support for focusing partnerships on major, well-defined challenges in areas of national interest like energy, health, and advanced manufacturing. Examples include developing autonomous laboratories, creating AI models for materials discovery, and digitizing historical nuclear data.
- **Contests and Prize Challenges:** The DARPA model of running focused, milestone-driven competitions was frequently praised. Such contests, including hackathons and the Triage Challenge, are seen as effective mechanisms to stimulate innovation, generate preliminary data, and encourage participation from a wide range of institutions.
- **New Engagement Mechanisms (and old ideas that can be scaled):**

- **Citizen Science:** Engaging the public through citizen science initiatives for tasks like data labeling or donating Graphics Processing Unit (GPU) cycles (similar to SETI@home) was proposed as a way to broaden participation.
- **Open Data Stacks:** Creating shareable, open datasets is seen as a key enabler for collaborative projects.
- **Public Engagement:** Framing projects around topics that resonate with the public is crucial to build broad support and communities of practice.

Question 4: What are effective examples of macro-scale partnerships, spanning labs, industry, and universities? How come nobody ever tried...? (And what are some terrible examples?)

Successful partnerships, such as the Human Genome Project, the development of the internet, and the National Quantum Centers, were cited as models that demonstrate the power of a clear, unifying vision, significant government investment, and a structure that engages multiple stakeholders. These successes were often born from a snowball effect where initial government funding created a foundation that industry and other partners could build upon. In contrast, failed or “terrible” partnerships were characterized by a lack of integration, misalignment of goals, and situations where partners were assembled merely to meet proposal requirements without genuine collaboration.

Participant Feedback:

- **Successful Examples:**
 - **Human Genome Project and The Internet:** Participants highlighted both as highly successful, internationally collaborative efforts that began with government investment and were driven by a grand challenge. Their success was amplified by making the resulting data and technology (open source) widely available, creating enormous societal impact.
 - **National Quantum Centers and National Science Foundation Engines:** Participants named these examples as good, recent models that are focused, keep partners engaged, and are built on the right incentives.
 - **COVID Vaccine Development (Project Warp Speed):** This effort was cited as an example of successfully bridging the “valley of death” between research and manufacturing by combining decades of foundational investment (mRNA technology) with mission-driven urgency.
 - **IBM-Illinois Discovery Accelerator Institute:** Participants praised this institute for its open-source framework, which minimizes conflicts over IP.
- **Failure Patterns:**
 - **Lack of Integration:** Partnerships fail when they are not truly integrated. An example given was a partnership where one partner handled all education and the other handled all research, with no real synergy.

- **Superficial Collaboration:** Many partnerships are described as terrible when they are formed superficially to satisfy a funding requirement rather than being built on a foundation of shared mission and motivation.
- **Unclear Governance:** Partnerships without clear governance, management structures, and pre-defined expectations are prone to failure.

Questions 5 and 6: What can universities and philanthropy bring to the table, beyond workforce development and funding? And what are the changes in policies and norms that would make it easier for universities to partner?

Beyond their core roles, universities bring invaluable entrepreneurial energy, a diversity of disciplinary expertise, and the freedom to pursue high-risk, foundational research that might fall outside a funding agency's immediate mission. Philanthropic organizations are seen as crucial "risk leaders" capable of providing early-stage, flexible funding for uncertain but potentially transformative research that industry would not support. To make it easier for universities to partner, a fundamental shift is needed in institutional policies and culture, particularly in how promotion and tenure (P&T) structures recognize and reward team science, applied research, and interdisciplinary collaboration.

Participant Feedback:

- **Unique Contributions of Universities:**
 - **Entrepreneurial and High-Risk Research:** University faculty and students are entrepreneurial and can adapt quickly to new opportunities. They have the freedom to pursue high-risk, curiosity-driven work that is not tied to a specific agency mission.
 - **Disciplinary Diversity:** Universities offer a breadth of expertise, including in the social sciences and humanities, which is critical for understanding the societal impact of new technologies.
 - **Neutral Convener:** Universities can act as hubs or "talent concentrators" that bring together different partners.
- **Role of Philanthropy:**
 - **De-risking Agent:** Philanthropies can act as risk leaders by investing in early-stage, high-risk research where the outcomes are uncertain. They can provide the initial seed funding that is difficult to secure from industry or government.
 - **Venture Philanthropy:** Younger philanthropic organizations are exhibiting venture capital-like behaviors, which could be leveraged to support innovative projects.
- **Needed Changes in Academia:**

- **Modernize P&T:** The current P&T structure, which heavily favors individual achievement and traditional publications, is a major barrier. It needs to be updated to recognize and reward contributions to team-based projects, applied research, and other outputs like software or datasets.
- **Streamline Legal and Administrative Processes:** Universities need to adopt more flexible and efficient approaches to IP negotiations and contracting. Educating university lawyers about research agreements and developing uniform contracting policies would help.
- **Incentivize Collaboration:** Faculty incentives, which are often salary-based and tied to individual grants, need to be restructured to encourage participation in large-scale partnerships.

Additional Emergent Themes and Insights

The Central Importance of a Unifying National Vision

A recurring theme across all discussion groups was the critical need for a clear, compelling, and shared national vision, akin to the Space Race or the Manhattan Project. Participants argued that transformation at the scale envisioned by the Genesis Mission requires more than just funding mechanisms; it demands a bold, outcome-oriented goal that resonates beyond the research community and unifies academia, industry, and government. This vision must be articulated in terms of a national purpose, such as “Ensure America’s enduring leadership in science and discovery,” and be supported by a sustained public communications campaign.

Post-Vannevar Bush Era Realignment

There was a strong sense that the research and development (R&D) ecosystem is in a “post-Vannevar Bush era” and requires fundamental rethinking. The old model, where federally funded academic research naturally fed into industrial innovation, is seen as broken or inefficient. Participants called for a new, more intentional ecosystem where the roles of academia, industry, philanthropy, and National Laboratories are strategically realigned. This effort includes creating new trilateral models for collaboration, providing tax credits for industry-supported university research, and ensuring that federal funding for foundational science is better coupled with industry-driven needs and directions.

The Need for Trusted Intermediary Institutions

Several discussion groups proposed the establishment of independent, trusted consortium leaders or intermediary institutions to manage and integrate these complex partnerships. These organizations, such as university affiliated research centers or federally funded research and development centers, could operate at the intersection of different sectors, ensuring mission alignment, upholding partnership principles, and reducing friction between partners. Their role would be to serve as neutral, trusted integrators, allowing academic and industry partners to collaborate more effectively without getting bogged down in direct, bilateral negotiations. Many groups suggested joint university-National Laboratory researcher appointments.

National Science and Technology Challenges

Breakout Sessions

Following is a consolidated summary of the key findings from the discussion on National Science and Technology Challenges, synthesizing feedback from multiple participant groups.

Overall Summary

Participants collectively advocated for a strategic, cross-cutting approach to the National Challenges, emphasizing that the true goal is not just to accelerate science but to build a foundation for *trustworthy, AI-driven discovery*. Their feedback strongly supports organizing efforts around thematic, horizontal capabilities rather than pursuing 26 separate initiatives. Key recommendations include developing shared platforms for autonomous labs, digital twins, and data curation, which would benefit multiple challenges simultaneously.

Three primary pillars for success were identified:

- **Rethinking Collaboration:** Success hinges on moving beyond siloed work. It requires creating integrated, transdisciplinary teams of domain scientists and AI specialists, supported by new roles like research software engineers (RSEs). This new team science model must be reinforced by aligning academic and institutional incentives to reward collaboration, data sharing, and software development, not just traditional publications.
- **Strategic Partnerships:** Universities are crucial for providing foundational research and a pipeline of cross-trained talent, while philanthropic organizations can offer catalytic, high-risk capital to bridge gaps and foster open science. These partnerships are essential for building a diverse and agile research ecosystem.
- **Prioritizing Foundational Infrastructure:** A significant issue identified across nearly all challenges is the lack of high-quality, AI-ready data. Therefore, a primary focus should be on building data factories through autonomous laboratories to generate new, systematic data. Furthermore, streamlining access to DOE's high-performance computing resources is critical to enabling the agile, exploratory nature of AI research.

In essence, a systemic redesign of the research enterprise—spanning collaborative structures, incentive models, and foundational data infrastructure—is necessary to realize the transformative potential of AI for science, energy, and national security.

Summary by Question(s)

Question 1: Which National Science and Technology Challenges will most benefit from workshops to establish research agendas?

The consensus among participants was that workshops are a critical mechanism for advancing the National Challenges, but a one-size-fits-all approach is ill-advised. Instead of holding 26 distinct workshops for each challenge, the feedback strongly favored thematic, cross-cutting workshops that bring together diverse stakeholders from National Laboratories, academia, and industry. The primary goal of these workshops should be to build communities, identify shared problems, establish common research agendas, and define the “rules of engagement” for collaboration. Challenges that are broad, require significant data integration, or touch upon foundational AI and hardware co-design were seen as the most immediate beneficiaries.

Participant Feedback:

- **Prioritize Cross-Cutting Themes:** Participants advocated for workshops focused on horizontal themes that span multiple National Challenges. Key examples include:
 - **AI-Driven Autonomous Laboratories:** An underlying capability for many science challenges, requiring a dedicated roadmap and partnerships.
 - **Data Curation and Architecture:** A recurring need across domains for creating and managing high-quality, standardized, AI-ready datasets.
 - **Trustworthy Digital Twins and Physics-Informed AI:** A universal need for integrating physical laws with AI models to ensure reliability and trust, especially in high-consequence systems.
 - **Advanced Manufacturing and Microelectronics:** Areas that involve highly proprietary data, making workshops essential for establishing pre-competitive collaboration frameworks.
- **Strategic Grouping:** Rather than addressing all 26 challenges individually, which is seen as impractical, participants suggested clustering them into manageable, thematic groups (e.g., a “nuclear cluster” or “materials cluster”) or focusing on foundational capabilities like “Tools for Decision Making” and “Control of Complex Systems.”
- **Purpose-Driven Workshops:** The purpose of the workshops should be clearly defined, whether it is to build DOE/academia partnerships, solve specific technical bottlenecks, or create a framework for success. A tiered workshop approach was proposed, including National Challenge workshops for high-level problem scoping, technical workshops for deep dives into specific scientific components, and social, behavioral, and economic workshops focused on overcoming barriers such as IP friction, incentive alignment, and team dynamics. Unconference-style sessions were also suggested to encourage open discussion about failures and lessons learned.
- **Inclusivity and Community Building:** A primary benefit of workshops is bringing together domain experts, AI specialists, early-career researchers, and students to foster a collaborative community.

Question 2: What kinds of resources are needed for the teams working on the National Science and Technology Challenges to be successful?

Participants agreed that success requires a strategic blend of funding, talent, infrastructure, and streamlined collaboration. Beyond substantial federal funding for research and infrastructure, there is a critical need for flexible funding mechanisms to support software engineers, AI technicians, and interdisciplinary teams. Other key resources identified include simplified access to high-performance computing, standardized frameworks for intellectual property and data sharing to reduce friction, and robust data infrastructure focused on generating and curating high-quality, AI-ready datasets. Overall, the consensus was that a holistic approach is necessary, where resources are allocated not only to the core scientific problems but also to the people and systems that enable discovery.

Participant Feedback:

- **Human Capital and Talent Pipeline:**
 - Participants consistently highlighted the need to fund a diverse range of personnel beyond faculty, including AI technicians and dedicated RSEs who can bridge the gap between domain science and AI/high-performance computing (HPC).
 - There was a strong call for funding graduate students, postdocs, and training programs (like fellowships and internships) to build a sustainable talent pipeline.
 - Recruiting and retaining talent is a major challenge, with recommendations to make graduate fellowships more attractive and to create clear career paths for technical staff.
- **Computing and Data Infrastructure:**
 - Simplified, flexible, and reliable access to HPC resources is essential. The current barriers to entry for DOE supercomputing are seen as too high for the agile, exploratory nature of AI research.
 - A major resource need is the infrastructure to generate new, high-quality, AI-ready data—so-called data factories or autonomous labs.
 - Participants emphasized the need for data curation resources and common data standards and formats to ensure interoperability and break down silos.
- **Funding and Collaboration Frameworks:**
 - Flexible and agile funding models are needed to adapt to the rapid pace of AI research, moving away from slow, rigid grant cycles. Suggestions include funding for professional PhDs, internships, and team-based training grants. Federal agencies should also adopt a higher-risk, portfolio-based approach and a “take risks and kill projects” mentality.

- Clear, standardized templates for IP and data-sharing agreements are necessary to reduce friction and accelerate collaboration between universities, National Laboratories, and industry.
- There is a recognized need for dedicated funding for administrative management to coordinate large, complex inter-institutional projects.

Question 3: What resources, ideas, or approaches can universities and philanthropies bring to the initial challenges in science, national security, and energy?

Universities and philanthropies are viewed as essential partners that provide critical resources beyond direct federal funding, though their roles are distinct. Universities are the primary engines for foundational research, talent development, and intellectual diversity. Philanthropy, while smaller in scale, offers catalytic, high-risk capital that can bridge gaps, pilot new initiatives, and fund efforts that fall outside traditional federal incentives. A key theme is the need for new models of engagement that leverage the unique strengths of each sector to accelerate progress.

Participant Feedback:

- **University Contributions:**

- **Talent and Workforce:** Universities are the primary source of the future workforce, including students and postdocs. There is a strong call to fund training programs, fellowships, and internships alongside research to build a pipeline of talent proficient in both domain science and AI.
- **Foundational Research and Innovation:** Universities excel at high-risk, “blue sky” research and can explore unconventional ideas. They bring intellectual diversity and a culture of open inquiry that is crucial for breakthroughs.
- **Neutral Evaluation and Benchmarking:** As neutral parties, universities are well-positioned to create benchmarks, validate models, and act as honest brokers in assessing the trustworthiness and quality of AI systems, a role that mission-driven labs or profit-driven industries may not be suited for.
- **Agility and Lower Costs:** University research can be more agile and less expensive than work at National Laboratories, making it ideal for scalable exploration and early-stage development.

- **Philanthropic Contributions:**

- **Catalytic and High-Risk Funding:** Philanthropic organizations can provide seed funding for high-risk, long-horizon, or pre-competitive work that federal agencies may not support, such as developing open-source tools or data standards.

- **Bridging Gaps:** Philanthropies can fund inter-institutional collaborations, workshops, and the creation of shared datasets, acting as a “catalytic wedge” to de-risk ideas for larger-scale investment.
- **Fostering Open Science:** Philanthropies are often strong advocates for open science and can fund the creation of open datasets and models as a public good.
- **Supporting Non-Traditional Areas:** Philanthropies can support efforts that fall between incentive structures, such as ethics in AI or STEM education initiatives at the K–12 level.

Question 4: How can domain scientists work with AI specialists and DOE supercomputing resources to solve the most difficult unsolved problems?

Effective collaboration between domain scientists and AI specialists is considered a central challenge that requires deliberate structural and cultural solutions, not just co-location. The prevailing sentiment is that simply “throwing data over the wall” to computer scientists is ineffective. Success hinges on creating integrated, interdisciplinary teams where knowledge is co-created. This involves establishing common vocabularies, aligning incentives, and developing new team structures and training models. Access to DOE’s HPC resources must also be streamlined to support these new modes of work.

Participant Feedback:

- **Integrated Team Models:**
 - **“T-Shaped” Professionals:** The most successful model is seen as transdisciplinary, where domain experts gain AI proficiency or vice versa. This model requires investment in cross-training, such as co-supervising students or creating dual-degree programs.
 - **Research Software Engineers:** Participants identified a critical need for dedicated staff, such as RSEs or AI technicians, who act as a bridge between domain science and HPC, translating problems and embedding best practices within teams.
 - **Team-Based Science:** There is a call to move beyond individual investigator-led projects toward co-led, co-funded centers and bottom-up team formations, similar to models used in DOE’s Bioenergy Research Centers or high-energy physics collaborations.
- **Aligning Incentives:**
 - A significant barrier is the misalignment of academic incentives. AI specialists may not be rewarded for applying existing methods to scientific problems, which may not be seen as novel in computer science.

- Solutions proposed include creating new career paths for support staff, valuing team-based contributions in promotion and tenure, and framing problems as competitive challenges that are prestigious to solve.
- **Streamlining HPC Access:**
 - The barrier to entry for using DOE supercomputing resources is too high. Simplified and more flexible allocation models are needed, especially for the exploratory and rapidly evolving nature of AI research.
 - Providing a user community and onboarding support is as important as the hardware itself.
- **Fostering Communication:** Building a common language and mutual understanding is crucial. Workshops, joint appointments, and long-term embedded collaborations (one to two years) were cited as effective mechanisms. Community building, with strong onboarding support, is also seen as essential.

Additional Emergent Themes and Insights

Beyond the specific questions, several overarching themes emerged consistently throughout the discussions, pointing to systemic challenges and opportunities for the Genesis Mission.

The Centrality of Trust over Speed

A powerful counter-narrative emerged regarding the goal of the Genesis Mission. Participants argued that the true challenge is not merely accelerating science but ensuring the *trustworthiness* of AI-driven discoveries. In high-consequence domains like national security and energy, an output from an AI model is useless without rigorous validation, uncertainty quantification, and clear evidence that documents its reliability. This reframes the mission from a focus on raw productivity to a focus on building a culture and infrastructure for verifiable, credible, and robust AI.

Systemic Redesign of the Research Ecosystem

There was strong consensus that AI cannot simply be “bolted on” to the existing research enterprise. To realize the transformative potential of AI, the institutional structures that govern science must be redesigned. This includes:

- **Academic Reward Structures:** Promotion and tenure incentives need to move beyond publication counts to value contributions like creating high-quality datasets, developing open-source software, building infrastructure, and participating in team-based science.
- **Data and IP Policies:** Frictional IP and data-sharing agreements, particularly between universities and industry, are major concerns. Standardized templates and a culture of open science are needed to accelerate collaboration.

Data Generation as a Primary Bottleneck

A recurring theme was that for many scientific domains, the bottleneck is not a lack of computational power but a lack of high-quality, AI-ready data.

- **“Smart Data” over “Big Data”:** Instead of simply digitizing historical data graveyards (which are often messy and biased), the focus should be on generating new, systematic, and modular data through autonomous labs. This concept was framed as “creating science for AI,” not just “AI for science.”
- **Autonomous Labs as Data Factories:** Automated and autonomous laboratories are seen as critical infrastructure—data factories—that can close the loop between prediction and experimentation, iteratively generating clean, structured data to train the next generation of foundation models.
- **Vendor and Standards Lock-In:** A major obstacle, especially in experimental science, is vendor lock-in for instruments and a lack of data standards (ontologies, file formats). The feedback suggests using DOE’s purchasing power to mandate interoperable standards.

The "Build Once, Deploy Everywhere" Platform Vision

Participants noted that the 26 National Science and Technology Challenges are not entirely unique problems but often represent domain-specific applications of a shared technical playbook. This led to a strong call for developing a reusable, shared technical stack that could serve multiple challenges simultaneously. Key components of this shared platform include:

- **A Shared Digital Twin Framework:** A common platform for creating virtual replicas of physical systems (reactors, accelerators, etc.) that can be customized with domain-specific physics plug-ins.
- **A Common Agentic Workflow Engine:** A robust platform for automating the design-test-analyze pipeline, applicable across domains from drug discovery to materials qualification.
- **Shared Physics-Informed Foundation Models:** A core capability that constrains neural networks with known physical laws, which can be developed as a shared methodology.
- **A Common Data Engineering Pipeline:** A standardized toolkit for data digitization, curation, and provenance tracking that would benefit numerous challenges.

Computing and Data Ecosystem Breakout Sessions

Following is a consolidated summary of the key findings from the discussion on the computing and data ecosystem, synthesizing feedback from multiple participant groups.

Overall Summary

The successful integration of AI into the national research landscape is currently hindered more by foundational infrastructure and governance issues than by a lack of advanced algorithms. Participants across all groups identified the primary issue as the widespread lack of AI-ready data, which is often inaccessible, poorly curated, and lacks consistent formatting and metadata. This data challenge is compounded by a fragmented computing environment, insufficient networking, and a critical shortage of skilled personnel, such as RSEs, who can bridge the gap between scientific domains and complex AI workflows.

To address these issues, a strong consensus emerged on the need to establish clear, standardized governance and trust frameworks before implementing technical solutions. These frameworks must resolve complex issues of data ownership, intellectual property, and security to reduce friction in collaborations between universities, National Laboratories, and industry. Participants advocated for new policies that incentivize data sharing by rewarding researchers for producing high-quality, curated datasets.

The discussions also highlighted complementary roles for universities and National Laboratories. Universities may be the ideal environment for exploration, experimentation, and workforce development, while National Laboratories could be better suited for large-scale, mission-oriented “exploitation” of established AI models. There were concerns expressed by university representatives that the value proposition of the Genesis Mission for universities was still unclear—what are they expected to provide and get out of it? RSEs and data scientists are seen as the essential human infrastructure needed to connect these two spheres and ensure research is reproducible.

Finally, participants called for a significant overhaul of resource allocation policies. The current rigid, proposal-heavy system is poorly matched to the dynamic and exploratory nature of AI research. The proposed solution is a flexible, multi-tiered model that allows for rapid, low-friction access for exploratory projects while still supporting large-scale production workloads. Emergent ideas included creating a “Genesis Corps” of rotating fellows to build a cohesive national talent pipeline and the need for long-term federal funding to ensure the sustainability of these initiatives.

Summary by Question(s)

Question 1: What are the most important technical challenges to address?

Participants identified the primary technical challenges as a lack of robust, standardized data and computing infrastructure, rather than algorithmic limitations. The core issue is that data across institutions is often unusable or inaccessible due to inconsistent formatting, a lack of metadata and provenance, and insufficient resources for curation. This issue is compounded by a fragmented computing environment, inadequate networking, and a shortage of human expertise to bridge the gaps between domain science and advanced AI workflows.

Participant Feedback:

- **Data Readiness is the Main Blocker:** The most significant challenge is the lack of AI-ready data. Datasets often lack consistent formatting, metadata, provenance, and quality control, making them untrustworthy and difficult to use. There are no consensus standards on what “AI-ready” even means across different fields and data types.
- **Infrastructure Deficiencies:** A major challenge is the unpredictable and growing demand on infrastructure, including GPUs, networking, power, and cooling. Universities, in particular, often lack sufficient compute, storage, and data center capacity. Network infrastructure is frequently overlooked and under-resourced but is essential for real-time experimentation. Sandbox computational platforms were suggested for student and researcher access before they step up to larger-scale resources, and to make use of local datasets that may be hard to share. Balancing selective data retention while maintaining robust documentation about what was discarded and why was proposed as an important strategy to combat large data volumes. Additionally, the competition between on-premises versus cloud services was mentioned as an important consideration.
- **Lack of Integration and Standardization:** There is a critical absence of unified integration layers connecting AI tools, HPC systems, and robotics platforms. Researchers are forced to build and manage their own disconnected ecosystems, which limits scalability and reproducibility. Accurately matching resources with needs, both at the university and the systemic level, was also cited as a core challenge.
- **Human Expertise Gap:** A significant concern is the shortage of personnel with the skills to use HPC and AI workflows effectively, such as RSEs and data scientists embedded within scientific domains.
- **Data Curation and Security:** High-quality data curation is a major challenge, as the process is technically immature and inconsistently applied. Developing secure and compliant data pipelines for sensitive data across universities, National Laboratories, and industry is a complex, unsolved problem and will require technically robust approaches for access control, auditing, and policy-aware data movement that do not yet scale cleanly. What becomes of data after a grant ends, and who pays for storage and curation in perpetuity, are also open questions.

Questions 2 and 3: What governance and trust frameworks are required to build an integrated ecosystem? What are the core policy and technical requirements for managing shared data, especially regarding ownership, multi-modal data integration, and security?

The consensus among participants was that building an integrated ecosystem requires establishing clear, standardized governance and trust frameworks *before* technical solutions are implemented. Key concerns revolved around data ownership, intellectual property, and security. Participants emphasized the need for pre-negotiated agreements and policies to reduce the friction of collaboration between universities, National Laboratories, and industry. Trust must be built through transparent processes, data provenance, and creating incentives for data sharing.

Participant Feedback:

- **Standardize Data Ownership and IP:** A default ownership and licensing rule for publicly funded data, especially for collaborations involving industry partners, is essential. Current IP policies, such as the Bayh-Dole Act, and fears of “getting scooped” can disincentivize data sharing. Standardized templates for data rights, publication boundaries, and IP are needed to accelerate collaboration. Agreeing on formats, ontologies, and structure for data storage so data are searchable, interpretable, and composable across labs and domains was also cited as crucial.
- **Establish Trust Frameworks:** Trust needs to be actively built. Suggestions include creating university “trust networks” that establish clear roles and responsibilities and ensure data provenance and traceability. Some participants proposed an “FDIC for trust” model, where institutions following best practices would be protected if hacked.
- **Incentivize Data Sharing:** There is a strong need for incentive structures that reward researchers for creating and sharing high-quality, curated data. Current academic incentives prioritize publications over datasets. Participants proposed solutions such as crediting data contributions like articles and providing computational resources in exchange for data sharing. An evolution of scientific culture is needed to encourage data sharing.
- **Establish Federated Data Governance:** A popular suggestion among participants was a federated model, where data remains in its “natural home” but is discoverable and accessible through a semantic data fabric. This approach helps manage security and ownership concerns. However, the lifetime for data storage needs to be determined.
- **Implement Security and Access Control:** Robust technical approaches for access control, auditing, and policy-aware data movement are required. This includes implementing role-based access control instead of “need-to-know” and leveraging solutions like homomorphic encryption for sensitive data.

Questions 4 and 5: What role should universities play in building and sustaining complementary AI infrastructure alongside National Laboratory resources? What role could RSEs or data scientists play in fostering “AI for science” research productivity?

Universities are seen as the primary engine for exploration, experimentation, and workforce development within the AI ecosystem, complementing the National Laboratories’ focus on large-scale, mission-driven projects. They provide the “readiness and experimentation layer,” fostering early-stage development and training the next generation of scientists. RSEs and data scientists are identified as the critical glue needed to make this ecosystem functional by translating domain needs into technical workflows and ensuring research is reproducible and portable.

Participant Feedback:

- **Universities as Hubs for Exploration and Training:** Universities are best positioned to serve as the ecosystem’s exploration arm, generating new hypotheses and “unreasonable” ideas that can later be scaled. They also provide essential workforce development by training students and acting as a talent pipeline for National Laboratories and industry.
- **Complementary Role to National Laboratories:** While National Laboratories excel at large-scale exploitation, universities can focus on longer-term, foundational research and act as regional hubs for computing and data. They can prototype on smaller, local systems before scaling to leadership-class facilities.
- **RSEs and Data Scientists as Critical Connectors:** RSEs and data scientists are vital for research productivity. Their role is shifting from simply writing code to validating AI-generated workflows, sustaining shared software, and enabling reproducible research across institutions. There is a need for formal programs and career paths to develop and retain this talent.
- **Bridging the Human Resource Gap:** Universities supply the “human power”—the talent and creativity of students and faculty. Programs that create structured partnerships, such as guaranteed internships at DOE labs for students, are needed to strengthen this pipeline.

Questions 6 and 7: What allocation policies are best for assigning computation and storage resources to individual research projects? What mix of simulation, training, and inference workloads need to be supported?

Current allocation policies are ill-suited for the fast-paced, exploratory nature of AI research. Participants strongly advocated for a multi-tiered allocation model that supports both rapid, low-friction exploration and large-scale production workloads. The existing, proposal-heavy process creates high transaction costs and perverse incentives. A more

flexible, marketplace-like system is needed to match diverse workloads with the appropriate hardware and software resources efficiently.

Participant Feedback:

- **A Multi-Tiered “Wish List” Model:** Participants proposed a staged access model:
 - **Tier A:** Rapid, low-friction credits for exploratory work with minimal paperwork.
 - **Tier B:** A fast-track upgrade path to larger systems if early results show promise.
 - **Tier C:** Full-scale allocations for validated, production-level workloads.
- **Flexibility Over Rigid Planning:** The current allocation process, which requires detailed, mature workflow plans, is a mismatch for exploratory AI research. The latency in obtaining resources means that by the time access is granted, the models or methods may already be outdated.
- **Incentivizing Data Sharing Through Allocation:** Allocation policies should be used to incentivize the sharing of data. Participants proposed a “data-for-data access” model, where depositing quality data grants access to compute resources.
- **Support for Heterogeneous Workloads:** The system must support a mix of simulation, training, and inference workloads, which have different hardware and software requirements. Not all workloads are large-scale; the “long tail” of smaller research projects must also be supported.

Additional Emergent Themes and Insights

Building on Existing Frameworks (What Already Works)

- A strong sentiment emerged that new initiatives should explicitly build upon what already works rather than creating parallel platforms.
- Specific, existing models mentioned as examples include the National AI Research Resource (NAIRR), ACCESS, and InCommon (for federated identity), and community repositories like the Protein Data Bank.

The Genesis Corps Concept

- A novel idea proposed was the creation of a “Genesis Corps” fellows program, modeled after medical schools’ Match Day or a civilian-style service corps.
- The program would create a pipeline of talent (e.g., funded fellows, RSEs) who could rotate between DOE labs, universities, and industry.
- The program would serve to transfer knowledge, build a cohesive national workforce, and provide applied staff who are not on a traditional tenure track.

Long-Term Federal Commitment

- Participants stressed that building a sustainable AI infrastructure requires long-term federal commitments, not just pilot programs.
- Participants suggested that 10-year commitments are necessary to outlive typical Ph.D. cycles, sustain technical staff, and drive deep adoption of AI tools in research and training.

Establishing National AI-for-Research Centers

- Participants proposed establishing approximately 10 national, hybrid, AI-for-research centers.
- These centers would span DOE labs, national facilities, and universities to integrate compute, data conditioning, secure data management, model training, and shared software.

Workforce Development and Engagement

Breakout Sessions

Following is a consolidated summary of the key findings from the discussion on workforce development and engagement, synthesizing feedback from multiple participant groups.

Overall Summary

Effectively integrating AI into the U.S. workforce and engineering sectors requires a transformative and collaborative effort that spans education, industry, and government. The current educational models are too slow and rigid to meet the urgent demand for AI-skilled talent. Participants strongly advocated for a multi-pronged strategy that includes creating flexible and accessible training pathways, such as online certificate programs and micro-credentials, to rapidly upskill both the current workforce and the next generation.

Central to this strategy is the need for deep, intentional partnerships between universities, National Laboratories, and private industry. These collaborations are essential for developing relevant curricula, providing critical experiential learning opportunities like internships, and ensuring that training aligns with real-world job demands. Participants see significant potential in using AI itself as an educational tool to create personalized, adaptive learning experiences that can accelerate skill development at scale.

Beyond technical training, a consensus emerged around the critical importance of fostering durable skills such as critical thinking, problem-solving, and adaptability. To attract more domestic students to advanced STEM degrees, participants highlighted the need for increased financial incentives, clearer career pathways, and a concerted effort to improve the public perception of STEM careers, starting from K–12. Success will ultimately depend on overcoming institutional inertia in higher education and building an educational ecosystem that is as dynamic and innovative as the AI technology it seeks to leverage.

Summary By Question(s)

Question 1: How can we enable scalable workforce development? What scalable programs can rapidly train both the next generation and current domain experts/faculty who lack AI experience?

The consensus among participants was that scalable AI education requires a multi-pronged approach that moves beyond traditional university frameworks. There was a strong emphasis on creating accessible, flexible, and practical training opportunities such as stackable credentials, micro-internships, and online certificate programs inspired by successful models like Georgia Tech's online master's program. A key theme identified was the necessity of strong partnerships between universities, National Laboratories, and industry to ensure curricula are relevant and to provide clear career pathways. Participants also stressed the importance of "just-in-time" skills training and experiential learning to meet the immediate needs of both the current and future workforce.

Participant Feedback:

- **Accessible and Flexible Education:** Participants advocated for expanding low-cost, accessible online degrees and certificates. They highlighted the need for stackable credentials, micro-credentialing, and modular courses that allow for progression and acknowledgement of skills and re-skilling. They also raised the idea of offering internal university certificates to external participants. Multiple groups mentioned the high-concept idea of a national service model for AI training such as the Reserve Officers' Training Corps (ROTC) or AmeriCorps, with free tuition but a requirement for service.
- **University-National Lab-Industry Collaboration:** A strong theme was the need for partnerships to co-develop curricula for training National Laboratory staff and other professionals in AI innovation. The curricula would include creating “just-in-time” short courses with STEM expertise and immersive sabbaticals for the current workforce.
- **Experiential and Work-Integrated Learning:** Participants supported experiential learning models, including co-op programs, apprenticeships for high-end technicians, and “AI in the field” experiences for all undergraduates. Paid micro-internships were suggested as a way for students to gain work experience while also providing low-cost opportunities for firms, starting with data challenges that come from industry and meeting industry where they need the help.
- **Training the Trainers:** A critical component is the need to train educators and faculty on how to integrate and teach AI. Suggestions included creating “teach-the-teachers” programs for K–12, faculty fellowships, and establishing communities of practice.
- **Standardization and Resources:** Participants also mentioned the potential role of professional societies in standardizing training infrastructure. NAIRR was cited as a good model for providing resources to educators.

Question 2: How can we use AI itself to create personalized training that accelerates workforce development at all levels?

Participants saw significant potential for AI to revolutionize education by providing personalized, adaptive, and scalable training. The core idea is to use AI as a tool to move beyond a one-size-fits-all model and create customized learning paths based on individual student needs, styles, and existing knowledge. Key applications discussed include AI-powered tutors, personalized assessments to identify knowledge gaps, and AI-driven content generation. However, participants shared a strong cautionary note to ensure that the human element of teaching and critical thinking is complemented, not replaced, by AI.

Participant Feedback:

- **Personalized Learning and Tutoring:** AI can serve as a personal, one-on-one tutor available 24/7, adapting to each student's pace and learning style. AI could be used to explain complex topics, provide customized feedback on assignments, and help students explore subjects they are interested in.
- **Assessment and Skill Gap Analysis:** AI can be used to assess an individual's skills and knowledge at the outset of training to create a customized learning plan. It can also generate personalized quizzes and assessments to identify and address individual knowledge gaps in real time.
- **Content and Curriculum Development:** AI can assist in developing AI-assisted textbooks and course materials, potentially making education cheaper and more accessible. It can also be used to mine research publications to keep curricula current and relevant. AI teaching assistants could help with course management.
- **The Human-in-the-Loop:** A recurring theme among participants was the need to be careful about removing the human component. AI should complement and enhance the teacher's role, not replace it. The AI classroom experience could shift to a more interactive discussion/chat model, which would be more demanding for teachers. Thus, there is a need to teach students how to use AI as a tool and not as a crutch, including the skill of critically questioning AI-generated output. Participants frequently mentioned the importance of students retaining the ability to "learn how to learn."
- **Data and Infrastructure:** Large, high-quality datasets need to be built for training educational AI models. Participants suggested that student competitions could be one way to assemble and vet these datasets.

Question 3: What specific collaborations are needed to integrate AI for science in graduate or undergraduate curricula?

Participants agreed that integrating AI into science curricula requires deep, intentional collaborations between academia, industry, and National Laboratories. The feedback highlighted that these partnerships are crucial for curriculum development, providing experiential learning opportunities and ensuring that training is aligned with real-world needs. A significant obstacle, however, is the need to bridge the cultural and infrastructural gaps between the sectors. Participants believe that involving accrediting bodies like ABET early in the process would be essential for driving institutional adaptation and overcoming internal university resistance to change.

Participant Feedback:

- **Partnerships for Curriculum and Experiential Learning:** Universities should partner with National Laboratories and industry to support curriculum development, create "flipped co-op" models (where students work in residence and learn virtually), and embed industry-like experiences such as capstone projects into the undergraduate curriculum. Shorter, cheaper, and more flexible internship opportunities will help smaller institutions remain competitive.

- **Role of Accrediting Bodies:** Collaborating with accrediting bodies like ABET and the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) is critical. These organizations can generate demand for institutional adaptation and help overcome internal university obstacles to curricular change. It is important to get people who understand AI technology onto their boards.
- **Integrating Students and Professionals:** There is a need for more programs that integrate undergraduate and master's students into research projects. Bringing National Laboratory and industry professionals into high school and undergraduate programs was also suggested.
- **Overcoming Silos:** Collaborations are needed to flatten departmental silos within universities to facilitate cross-program education. Participants also noted that universities are often "modern institutions with medieval infrastructures," and industry does not always understand the academic curriculum, creating a cultural divide that must be bridged.
- **Funding and Incentives:** Financial incentives from government and industry are needed to encourage these collaborations. This includes funding for academic visitors to labs, industry-funded graduate programs, and incentives for universities to work with local businesses. Incentive structures must be aligned between academia and industry to ensure robust outcomes.

Question 4: How do we encourage more American citizens/students to pursue STEM doctorates, especially in AI-related fields?

To encourage more domestic students to pursue STEM doctorates in AI, participants proposed a multi-faceted strategy focused on financial incentives, early engagement, and shifting public perception. The core message was that the value proposition of a STEM doctorate needs to be made more competitive with other lucrative career paths like medicine or law. This involves not only increasing stipends and funding but also creating clearer job pathways and improving the image of STEM careers. Engagement must start early (K–12) and be sustained through experiential learning and mentorship.

Participant Feedback:

- **Financial Incentives and Job Security:** Participants strongly emphasized that "money talks." They advocated for increasing funding and stipends for graduate students to be more competitive with industry salaries and other professional degrees. Attaching funding directly to students rather than faculty grants was proposed, as was industry-funded master's and Ph.D. programs with service agreements. Lack of clear, high-paying jobs at the end of a Ph.D. is a major deterrent.
- **Early and Sustained Engagement (K–12):** There is a critical need to engage students in STEM throughout their education. Suggestions included creating student clubs, gamifying learning, conducting national challenges, and using science

museums for follow-up activities with AI. The current K–12 system is not seen as adequately motivating students for STEM careers.

- **Improving Public Perception and Cool Factor:** AI and STEM fields suffer from a negative public perception, including fears of job loss and cognitive offloading. A concerted marketing effort is needed to make these careers seem “cool” and valuable. This could involve using “ambassadors of STEM” like athletes or influencers and highlighting mission-driven, inspiring challenges.
- **Educational Flexibility and Pathways:** The traditional degree path is seen as too rigid. Participants suggested compressing degree timelines by offloading tedious work to AI, creating flexible credentialing options (e.g., master’s degree in math, doctorate in science), and better integrating community colleges and trade schools.
- **Mentoring and Experiential Learning:** Providing experiential learning exposure throughout high school and undergraduate studies is crucial. Mentoring and apprenticeships were highlighted as important for human-centered skill development such as critical thinking and problem-solving.

Question 5: Dream Big: What would you like AI to be doing for you/your institution in the next five years?

Over the next five years, participants envision AI transforming their institutions by tackling two primary challenges: reducing administrative and research drudgery and creating a more efficient, equitable, and personalized educational environment. The overarching sentiment is that AI’s greatest potential lies in its ability to automate monotonous tasks, thereby freeing up human talent to focus on higher-level creative, collaborative, and curiosity-driven scientific endeavors. There is a strong desire for AI to become a trustworthy and reliable partner in both research and education, accelerating the pace of discovery and enhancing the learning experience. While aspirational, this vision is tempered by the need to address ethical considerations, ensure trustworthiness, and manage the cultural shift towards human–AI collaboration.

Participant Feedback:

- **Automating Drudgery and Increasing Efficiency:** A recurrent theme was the desire for AI to handle dull, repetitive, and administrative tasks, such as automating the generation of reports, methods sections for research papers, and literature reviews, as well as streamlining bureaucratic processes related to grants, compliance, and contracts. The goal is to get rid of bureaucracy and allow researchers and educators to focus on more substantive work.
- **Accelerating and Inspiring Scientific Discovery:** Participants see AI as a powerful tool to accelerate science, such as using it to synthesize relevant scientific literature, discover new algorithms, improve the AI–physical interface for robotics, and even help design and run autonomous labs. The hope is for AI to inspire new research directions and make the entire research process more efficient and abundant.

- **Creating a “Data-Driven University”:** Some participants envision AI enabling a data-driven institution where administrative and operational efficiencies are vastly improved. This includes optimizing space utilization, reducing energy consumption, and using data to support faculty in forming research teams and seeking awards.
- **Ensuring Trustworthiness and Ethical Use:** A critical caveat to these aspirations is the need for AI to be a trustworthy and reliable source. Participants stressed the importance of developing AI that can reliably estimate its own uncertainty and fact-check its outputs. There was also a strong emphasis on the “Hippocratic AI” principle of “First, do no harm,” addressing concerns about the public’s perception of AI and its potential for misuse.
- **Fostering Human-AI Partnership:** The ideal future involves a symbiotic partnership between humans and AI. Participants hope AI can inspire creativity and act as a thought partner, nurturing the uniquely human quality of curiosity. The goal is not to replace human intellect but to augment it, propelling curiosity-driven science and innovation and democratizing access to information and education.

Additional Emergent Themes and Insights

The Foundational Importance of Durable Skills

A significant theme that emerged across multiple discussions was the critical need to cultivate foundational or durable skills alongside technical AI competence. Participants noted that employers increasingly need people who are open-minded, flexible, and curious, and possess strong problem-solving, communication, and critical thinking abilities. It was suggested that a workforce readiness checklist would be approximately 70% durable skills and 30% technical skills. This emphasis on liberal arts-style thinking is seen as vital for a workforce that needs to be adaptive and innovative.

Challenges in the Higher Education Model

Participants frequently pointed to systemic challenges within the higher education model that hinder rapid adaptation to the age of AI.

- **Institutional Inertia:** Universities were described as being slow to change, with antiquated degree programs and faculty governance acting as obstacles.
- **Funding and Financial Aid:** The current federal financial aid model (Title IV) was identified as a barrier because it limits opportunities for hybrid work and schooling, which is essential for lifelong learners.
- **Prestige vs. Scale:** A tension was noted between the prestige of an institution, which often correlates inversely with scale, and the need to educate a broad and diverse student landscape.

AI Ethics, Bias, and Literacy

The importance of AI ethics, bias, and general AI literacy was a consistent thread throughout the discussions. Participants stressed that curricula need to address the ethical implications and potential biases in AI systems. The goal is to produce good digital citizens who can critically assess AI outputs and understand the technology's limitations. They also noted that AI literacy is important for everyone, not just those in technical fields.

Research Productivity Breakout Sessions

Following is a consolidated summary of the key findings from the discussion on research productivity, synthesizing feedback from multiple participant groups.

Overall Summary

Participants view AI as a transformative force in research and science, offering significant advantages in accelerating discoveries, automating tasks, and democratizing access to complex tools. However, this optimism is tempered by substantial concerns regarding the potential for AI to diminish critical thinking, generate low-quality research, and exacerbate existing inequalities.

A central conclusion from the discussions is that traditional measures of productivity, such as publication counts, are outdated and inadequate for the AI era. Productivity must be redefined in terms of impact—the tangible transformation of scientific understanding, technological innovation, societal benefit, and economic value. Impact may manifest unevenly.

To realize AI's potential, a systemic overhaul is necessary that includes widespread AI literacy training for researchers, the creation of high-quality, curated datasets, and democratized access to computational resources. Furthermore, the discussions highlighted that even with perfect AI, the ultimate rate-limiting factors will be human creativity, judgment, and the physical constraints of experimentation.

Finally, significant emergent themes pointed to the need for fundamental reforms in academic culture. Participants called for new incentive structures that reward team science and risk-taking (including failure), a re-evaluation of the university's role in workforce development for an AI-driven world, and modernized rules for data governance and intellectual property to balance openness with security and proprietary interests. In essence, successfully integrating AI into research requires not just technological adoption, but a profound rethinking of how science is funded, practiced, evaluated, and taught.

Summary by Question(s)

Question 1: What are the most important AI advantages and disadvantages in research and science? How should/can we measure the advantages to achieve the things we care about?

Participants collectively viewed AI as a powerful tool for accelerating research by synthesizing vast amounts of data, automating tedious tasks, and exploring novel hypotheses. The primary advantages identified include enhanced efficiency, the democratization of access to complex tools, and the ability to uncover new scientific discoveries. However, participants mentioned significant disadvantages and concerns, including the risk of diminishing critical thinking and creativity, the potential for generating low-quality or unoriginal “slop” research, and the exacerbation of existing inequalities in access to technology. A core challenge is the difficulty in effectively measuring

productivity gains, with a strong consensus that traditional metrics like publication counts are inadequate and that new, impact-focused measures are urgently needed.

Participant Feedback:

- **Advantages:**
 - **Acceleration and Efficiency:** AI can significantly speed up research by automating tasks like literature reviews, data analysis, and even manuscript writing, allowing researchers to focus on higher-level thinking.
 - **New Discoveries:** AI excels at exploring complex, high-dimensional parameter spaces and identifying patterns that are beyond human capability, leading to new discoveries in fields like drug development and materials science.
 - **Democratization:** AI platforms can lower the barrier to entry for complex research tasks, making powerful tools and knowledge more accessible to a broader range of researchers and institutions.
 - **Collaboration:** AI can serve as a tireless collaborator, assisting with tasks and providing continuous support, which can be particularly beneficial for small science and individual researchers.
- **Disadvantages:**
 - **Reduced Creativity and Focus:** Overreliance on AI could lead to a decline in researchers' ability to think critically and creatively, potentially diminishing the capacity for breakthrough insights.
 - **Loss of Human Interaction:** A shift towards human-AI collaboration could reduce vital human-to-human interaction, which is crucial for mentorship, serendipitous discovery, and overall well-being.
 - **Quality Control:** The ease of generating content with AI risks a flood of low-quality papers and data ("AI slop"), making it difficult to discern impactful work. There is also a concern about AI models "hallucinating" or providing incorrect information.
 - **Ethical Concerns:** The potential for misuse, such as research misconduct through data manipulation or plagiarism, is a significant concern.
- **Measurement and Metrics:**
 - **Inadequacy of Traditional Metrics:** There was strong consensus that metrics such as number of publications or citations are lagging indicators and poor proxies for true productivity or impact.
 - **Focus on Impact:** Productivity should be redefined to focus on tangible outcomes, such as the generation of new knowledge that transforms

thinking, technological innovation, societal impact, and economic value. Not just faster, but better science.

- **Proposed New Metrics:** Suggestions for new metrics include the development of new capabilities, the creation of validated models, the successful transition of technology to practical applications, and the rate of progress on National Science and Technology Challenges.

Question 2: What does productivity mean or what should it mean? What are the metrics to measure productivity?

Research productivity should be redefined away from simple output metrics like publications and towards a more holistic, impact-oriented framework. Participants agreed that “impact” is the ultimate measure of productivity, encompassing transformations in scientific understanding, technological innovation, societal benefits (e.g., quality of life improvements), and workforce development. This redefinition requires considering the diverse perspectives of various stakeholders, including researchers, funders, universities, and society at large. A key challenge highlighted is that impact is often long-term and difficult to quantify, leading to a call for “fuzzy” or flexible metrics that encourage a focus on outcomes rather than gaming the system.

Participant Feedback:

- **Redefining Productivity as Impact:**
 - Productivity is not merely about doing things faster, better, or cheaper, but about the meaningful impact of the work.
 - The focus should be on how research changes the way we work, transforms people’s thinking, and leads to implemented solutions.
 - Different stakeholders define productivity differently; for society, it could mean lives saved or new opportunities created, while for a researcher, it might be a paradigm shift in their field.
- **Metrics for Measuring Impact:**
 - **Time-to-Impact:** A crucial goal is to shorten the “discovery to impact” timeline, which is currently estimated to be around 20 years.
 - **Beyond Publications:** Metrics should move beyond papers to include workforce development (e.g., quality of Ph.D. graduates), creation of new tools and capabilities, and adoption of research by industry and other institutions.
 - **The Value of Failure:** The system should recognize and even incentivize “productive failure,” where experiments that do not work still generate valuable data and learnings.

- **Stakeholder-Specific Metrics:** Metrics must be tailored to different goals. For example, progress on National Challenges can be a concrete measure, while workforce development requires tracking graduate outcomes. Impact is not a single measure but can vary in different domains.

Question 3: What will be needed for AI to help with productivity? What are the opportunities and challenges within partnerships for what is needed?

For AI to effectively enhance research productivity, participants identified a critical need for systemic changes in training, infrastructure, and institutional practices. A major theme is the necessity of building AI literacy among students and researchers, not just in how to use the tools, but also in understanding their limitations and ethical implications.

Broadening access to computational resources and curated, high-quality data is seen as essential to prevent a digital divide between well-resourced institutions and others. Furthermore, success hinges on fostering and earning trust and developing robust partnerships between academia, government, and industry, which requires clear communication, aligned interests, and modernized frameworks for contracting and intellectual property.

Participant Feedback:

- **Training and Education:**
 - There is a significant need for appropriate training to move beyond fear and misuse of AI. Students and faculty must be taught how to use AI tools effectively, critically evaluate their outputs, and understand when and where they are applicable—but this has to be done in a way that earns and demonstrates trust.
 - Education should be reframed to emphasize judgment and critical thinking over rote execution, as AI automates the latter.
 - Some participants suggested embedding AI literacy and micro-credentials into early university curricula for all students.
 - If everything is automated, what do we teach the next generation? Is AI the rising tide that lifts all boats or a tsunami that wipes everyone out?
- **Infrastructure and Access:**
 - **Data Curation:** The biggest barrier to leveraging AI is the lack of high-quality, curated, and digitized data. Quality control on input data is a major challenge.
 - **Access to Tools:** Access to AI tools and computing power needs to be broadened and democratized to avoid widening the gap between well-funded institutions and the rest.

- **User Interface:** The user-friendliness of AI tools can be a barrier to adoption. Interfaces like ChatGPT and AlphaFold are successful because they are easy to use.
- **Partnerships and Trust:**
 - **Building Trust:** Trust is fundamental for effective partnerships and for the adoption of AI tools. It requires reliability, understanding, and clear articulation of goals.
 - **Aligning Incentives:** Government and universities need to clearly define their objectives to make a compelling business case for partners.
 - **Operational Challenges:** Contracting, developing statements of work, and aligning interests are significant hurdles in forming effective partnerships.

Questions 4 and 5: If AI works perfectly well with research productively, what will be the rate-limiting aspect? In this futuristic reality, what must be true about this future or must not be true?

Assuming a future where AI functions perfectly to accelerate research, participants believe the primary rate-limiting factor will shift from technical execution to intrinsically human elements: creativity, judgment, and problem definition. The connection to the physical world—the time and resources required for experiments—will also remain a fundamental issue. A key “must be true” for this future is that human agency, curiosity, and ethical oversight remain at the forefront of the scientific enterprise. Conversely, a “must not be true” is the notion that AI will eliminate jobs wholesale without creating new roles or that productivity can be measured by simple, easily gamed metrics. There is also a strong sentiment that AI must not be allowed to “sell us BS as real,” underscoring the need for human validation and trust.

Participant Feedback:

- **Rate-Limiting Factors:**
 - **Human Ingenuity:** The ability to ask the right questions, define problems in ways that are meaningful, and exercise sound scientific judgment will become the most critical and limiting factors.
 - **Physical World Constraints:** AI cannot bypass the physical limitations of conducting experiments, fabricating materials, or running clinical trials.
 - **Data and Known Knowledge:** AI is limited by the data it is trained on. Expanding the frontier of “known knowledge” through new experiments will remain a challenge. Knowledge and impact are uneven—the digital divide still exists.
 - **Unintended Consequences:** Managing the social and economic consequences of AI, such as potential inequalities and the displacement of jobs, will become a major challenge.

- **What Must Be True:**
 - **Human-in-the-Loop:** Humans must retain a central role in guiding research, defining what is important, and ensuring ethical conduct. University research and the training of students must remain highly valued.
 - **Trust and Guardrails:** There must be a shared moral code and robust guardrails to prevent intentional or accidental harm. AI's outputs must be verifiable.
 - **Democratized Access:** Access to scientific research and AI tools must be improved and democratized to ensure broad participation and benefit.
- **What Must Not Be True:**
 - **AI as a Panacea:** It must not be assumed that AI will make all problems easier or that it can replace the need for ground-truth experiments and deep thinking.
 - **Focus on Simple Metrics:** The future system should not be focused on simplistic metrics that are easily gamed and fail to capture true impact.
 - **Industry Dictatorship:** We must not have a future where only industry dictates what is important or valuable in research.

Additional Emergent Themes and Insights

Reforming Incentive Structures and Academic Culture

A significant portion of the discussion centered on the idea that current academic incentive structures are fundamentally misaligned with the goal of fostering collaborative, high-risk, and impactful science.

- **Team Science vs. Individual Credit:** Traditional promotion and tenure policies that reward individual achievement are seen as a major barrier to the transdisciplinary collaboration required for complex, AI-driven science. There is a strong call to develop and implement new models for rewarding team science, perhaps using AI tools to help tease out individual contributions.
- **Rewarding Risk-Taking and Failure:** The current system heavily penalizes failure, discouraging the kind of high-risk, high-reward research that leads to breakthroughs. Participants advocated for a cultural shift, similar to that in Silicon Valley, where failure is seen as a “badge of honor” and data from failed experiments are considered valuable outputs.
- **Hindrance of Bureaucracy:** The slow pace of funding cycles and other bureaucratic processes is a major rate-limiting step. It can take one to two years to secure funding, stifling innovation. AI was proposed as a tool to help streamline proposal review and compliance.

The Role of Universities and Workforce Development

Participants extensively debated the evolving role of universities in an AI-driven research landscape, with a particular focus on student training and attracting talent.

- **Student Training and Compensation:** There is a concern that low stipends for Ph.D. students create an economic trade-off that deters top talent from pursuing advanced degrees. Suggested solutions include paying students more competitive salaries or creating new, accelerated pathways to integrate them into impactful research earlier.
- **Shifting from Knowledge to Skills:** The goal of graduate education should be to produce high-quality, skilled thinkers, not just to generate papers. The focus should be on developing students' critical thinking, judgment, and ability to use AI as a tool to deepen their understanding.
- **The Gap Between Big Science and Small Science:** Many of the proposed National Challenges are aimed at big science, but much of university research is “small science” done at the benchtop. There is a need to ensure that investments and tools also support and engage these smaller scale but vital research efforts.

Open Science, Data, and IP

A recurring theme was the tension between the push for open science and the realities of proprietary data, IP, and security concerns.

- **Open vs. Proprietary:** There is a need to find a better balance between encouraging open data and open-source models while respecting IP and proprietary constraints from industry partners. Participants suggested clearer, simpler rules leaning towards openness unless data is explicitly classified.
- **Data Provenance and Monetization:** Participants were concerned about external entities profiting from publicly or individually generated data without giving back to the creators. This concern points to a need to rethink IP rules and data governance in the age of AI.
- **Security:** The risk of malicious insertions into open-source code or data was noted as a significant security concern that needs to be addressed.

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The logo consists of three concentric, overlapping circles that create a sense of depth and rotation, resembling a stylized 'G' or a target.

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