Fostering Innovation Through Sociological Overhaul: A Proposal for a Community-driven Open Research Ecosystem (CORE)

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October 4, 2025

Abstract

This article analyzes the deep, systemic flaws within the current sociological structures in basic research. From peer review and publication culture to funding allocation and the tenure system, we reveal a structural crisis defined by broken feedback loops, perverse incentives, and the rise of academic monopolies. We argue that incremental fixes are insufficient and that a complete reform is now warranted. To this end, we present the vision for a novel Community-driven Open Research Ecosystem (CORE), a new paradigm or constitution for the entire community guided by the overarching Diversity Principle. The CORE is a dynamic, balanced, and self-regulating ecosystem designed to promote meritocracy and diversity, offering equal opportunity to all members while simultaneously applying monopoly-breaking measures against the top and securing a safety net for the bottom. By thoughtfully navigating its implementation challenges, a CORE can ensure fairness, transparency, and efficiency via its dual evaluation system in knowledge dissemination, resource allocation, and career advancement, creating the conditions for a new era of innovation in basic research.

Contents

1 Introduction: A Deep Structural Crisis Requiring a Complete Reform

The pace of scientific discovery, particularly in fundamental STEM fields, feels increasingly constrained. While the volume of publications explodes exponentially, truly paradigm-shifting breakthroughs — the kind that reshape our understanding of the universe and drive major technological leaps — seem fewer and farther between. We are, in many ways, victims of our own success. The very structures that once fostered scientific progress — traditional peer review, mainstream-oriented funding models, and the tenure system — now often act as barriers to innovation, perpetuating a culture of incrementalism, risk aversion, and, at times, even outright resistance to groundbreaking ideas. Minor tweaks and patches to the current aging system are insufficient. In essence, the sociological structures of science are in a position similar to that of science itself at its modern inception more than four centuries ago. In this sense, the current outdated ecosystem resembles ancient Greek science at that time and it can no longer support modern science with more mature paradigms [1]. We need a sociological revolution like Galileo’s for modern science to establish a new research ecosystem.

The existing system, despite its best intentions, has become increasingly dysfunctional with glaring flaws: a peer-review process that has become a broken gatekeeper with bias against the unorthodox rather than a safeguard of quality, a tenure system that often protects established interests and entrenched hierarchies more than academic freedom, a postdoc system that exploits early-career researchers stifling their creativity, funding mechanisms that favor safe bets over bold exploration, and so on. The consequences are clear: a slowdown in fundamental discoveries, a decline in public trust in science, and a growing sense of frustration within the research community itself. Such systemic failures have appeared in many, if not all, mature STEM fields. Repeated reports and analyses about the broken system in one long-standing subfield — theoretical high energy physics [2, 3, 4] are particularly alarming.

Drawing upon the analogy between the capitalist economy and basic research (in which intangible ideas are assets), we see that both types of activities are driven by innovation via revolutionary cycles [5]. Just like monopolies that have emerged upon the maturity of a free market without appropriate regulations (probably a common issue for any system with such a positive feedback loop), a similar monopolistic tendency appears in our academic world, where dominant scientists and elite institutions accumulate control over funding, prestigious publications, and the career advancement of younger researchers. The fundamental cause of the failure of the current system is that it fosters, rather than prevents, academic monopolies due to the absence of a healthy feedback loop with proper incentive mechanisms.

Unlike capitalism that is guided with prompt, direct financial incentives, the feedback in the innovation cycles of research is often indirect and much delayed. This makes peer review, as the key feedback links of scientific validation in the cycles, the most critical element in the failed ecosystem that needs transformation. Its failure is deeply intertwined with all the other issues in the system, creating a self-reinforcing cycle of stagnation. The problems of peer review are systemic: opaque corrupt processes, lack of incentives for quality review, inherent biases and randomness, promotion of groupthink and herd behavior, and a fundamental disconnect between the goals of review and the fostering of truly innovative research. Simply put, its process is an ineffective, slow, expensive, biased, inefficient, anti-innovatory, and easily abused lottery [6]: the important is just as likely to be filtered out as the unimportant. These are not issues that can be addressed with minor adjustments; they require a paradigm shift of how we evaluate and validate scientific knowledge.

This article argues that the time is ripe — indeed, urgent — for a fundamental transformation in how we conduct, evaluate, fund, and disseminate research. We need a Community-driven Open Research Ecosystem (CORE) based on the overarching Diversity Principle, a system that embraces diversity, openness, transparency, rigorous evaluation, proper incentivization, and, most importantly, the individual creativity and collective wisdom of the entire research community, forming a complete and healthy feedback loop unlike other incremental approaches. While our focus will be primarily on basic STEM research fields, where the need for a rigorous, quantitative approach is particularly paramount, the principles and benefits of a CORE could extend to other disciplines, including the social sciences, potentially revolutionizing the entire academic landscape. The OePRESS initiative [7] serves as a concrete example of how such a system could be implemented, but the broader vision transcends any single platform.

This article is a call to action. We will dissect the systemic failures of the current research ecosystem, focusing particularly on the critical need to overhaul peer review and complete a healthy feedback mechanism in research. We will then present the vision of a CORE, outlining its core principles and demonstrating how it can foster a more dynamic, diversified, and innovative research environment, and provide profound benefits that extend far beyond the walls of academia and into society as a whole. The time for incremental adjustments is over and a complete overhaul (i.e., establishing a CORE) is not merely desirable, but essential for continued innovation. The future of scientific discovery depends on our willingness to embrace a truly transformative change — to build a Community-driven Open Research Ecosystem that empowers individual researchers, accelerates innovation progress, and unlocks the full potential of human knowledge.

2 The Failure of the Current System

The current research ecosystem was crudely designed on an ad hoc basis to promote scientific advancement and used to be effective in the beginning of modern science development. It may still work to certain extent for nascent fields and directions emerging from other disciplines or cross-disciplinary studies. However, it has become less and less efficacious for traditional fields with established paradigms. It is currently plagued by a series of interconnected problems that are actively hindering innovation and undermining the integrity of the scientific enterprise. These flaws are not isolated incidents but systemic issues, deeply embedded in the structures and incentives that govern research today.

In the following, we will first examine issues within the individual main components of the system: peer review, journal publication, funding, and tenure. Then we will condense out and analyze the more fundamental systemic problems that lie in all aspects of the system: inherent resistance to innovation, academic monopolies, and perverse incentives that result in a broken feedback loop.

2.1 Peer Review Flaws

Peer review, far from being a mere procedural formality, is the critical system for evaluation that underpins virtually every aspect of the scientific enterprise. It determines not only which publications are accepted, but also which research projects receive funding, and, ultimately, which researchers advance in their careers. Its pervasive influence makes its current failures all the more damaging, creating a chokepoint that stifles innovation and undermines the integrity of the entire research ecosystem.

Failed Original Goals:
The peer review system was conceived as a critical mechanism to safeguard scientific standards and enhance the quality of scholarly papers in journal publications, to select the most deserving projects for funding and support, and to promote the most promising young researchers to suitable positions. Unfortunately, none of these original goals is achieved in today's practices.

An earlier study published in 1982 exposed arbitrary decision-making in peer review and its inability in identifying duplication [8]. Fraudulent papers, sometimes even hilariously absurd ones, keep getting published all the time even in the most prestigious journals [9]. There is little evidence that the review process actually works, let alone for improving the quality of scientific literature [6]. The more and more intense competition in academia has made the already problematic review processes even worse [10]. On the contrary, evidence has shown that it is not effective in detecting errors, plagiarism, and other issues in submitted papers. Comparison between preprints and their final published versions has shown little differences [11]. At times, peer review could even lower the quality in readability and scientific contents as authors may feel obligated to comply with even illogical suggestions by the reviewers.

The current tenure review system in universities is somewhat arbitrary and heavily affected by many social, cultural, and political factors other than the candidate's academic abilities [12]. Peer review ratings have also been shown to be a poor discriminator of productivity of grant applications [13]. The situation is better for time allocation at large user facilities using distributed peer review in a relatively independent, self-regulating sub-ecosystem where applicants are required to review other proposals to be qualified for competing for time allocation [14].

Gatekeeping and Bias Against the Unorthodox:
The system, often relying on a small number of reviewers, is inherently susceptible to bias, particularly against research that challenges established paradigms or proposes truly novel ideas. Reviewers, typically experts in their specific subfields, are naturally inclined to evaluate new research through the lens of existing knowledge. This can lead to a conscious or unconscious bias against work that challenges fundamental assumptions, proposes radical new approaches, or ventures into uncharted territory. The result is a system that rewards incremental progress within established frameworks while actively discouraging the kind of paradigm-shifting discoveries that drive scientific revolutions.

The historical record is replete with examples of groundbreaking papers, later celebrated, being initially rejected due to their perceived “implausibility” or conflict with prevailing theories [15, 16, 17]. Satyendra Nath Bose’s paper on a new method of quantum statistics was first rejected by the *Philosophical Magazine* and later published with the assistance of Albert Einstein. It laid the foundation of Bose–Einstein statistics that describes laser and other coherent phenomena in quantum physics. Enrico Fermi’s seminal paper on beta decay was rejected by *Nature* [1], one of the most prestigious science journals, and he had to publish revised versions later in other languages and thankfully received the Nobel prize in 1938. In 1943, Ernst Stueckelberg was the first to formulate the renormalization procedure solving the infinities in quantum electrodynamics, but his paper was rejected by the *Physical Review* and unfortunately earned him nothing. Similar studies were published several years later by Tomonaga, Schwinger, and Feynman who were jointly awarded the 1965 Nobel Prize. Peter Higgs’s famous paper on the Higgs mechanism that explains mass generation in elementary particles was first rejected by *Physics Letters* and later published at *Physical Review Letters* with Yoichiro Nambu as the referee. They both won the Nobel prize later, and deservedly so. For an example outside of STEM, consider economist George A. Akerlof’s seminal paper, “The Market for Lemons,” which introduced the concept of “asymmetric information”. The paper was rejected several times before being published, and it earned Akerlov the Nobel Prize in 2001.

A 2015 study [19] unveiled that three of the top medical journals rejected all 14 of the top-cited articles that were eventually published elsewhere. As shown in Fig. 2 of Ref. [19], the traditional peer review process is a gatekeeper that simultaneously rejects manuscripts in both the lowest roughly 20% and the top 2% (i.e., 14 top-cited) in terms of citations, and kind of randomly accepting a certain fraction (about 5% for these prestigious journals) of submissions of quality in between 20-98%. Assuming that citations represent quality roughly in this context, the significance of the top 2% articles may greatly outweigh the insignificance of the bottom 20%. In this sense, the current peer review system is a blocking force to innovation. The situation may be far worse as citations do not truly represent the quality or scientific merit of a paper and some extremely transformational papers or ideas may not receive any recognition within a few years of its birth.

Even arXiv.org, the largest eprint service, initially designed to be open-minded and promote the rapid exchange of new ideas, has adopted monopolistic, gate-keeping moderation practices. In its effort to filter out a small fraction of potential “crackpot” papers — a figure shown to be merely 2% of all submissions — the platform risks inadvertently discarding genuinely disruptive ideas [5]. These aggressive screening policies have drawn increasing criticism in recent years [20, 21], and have spurred the creation of alternative services like viXra.org. The same gatekeeping impulse pervades other critical stages of

[1] Fermi’s biographer David Schwartz [18] argues that a more logical British journal that rejected Fermi’s paper would have been the *Proceedings of the Royal Society*.

the research cycle, such as funding and hiring, where peer review holds a similarly conservative bias. Indeed, studies have starkly concluded that the traditional peer review process has irremediable flaws in its ability to select for daring and innovative ideas during grant evaluation [22].

Incentive Crisis:

The effectiveness of peer review hinges on the willingness of researchers to provide thorough, thoughtful, and objective evaluations. However, the current system offers few, if any, incentives for high-quality reviewing. It is largely an uncompensated, time-consuming task, often viewed as a burden rather than a valued contribution. The system mostly relies on a fragile sense of academic duty from unrewarded reviewers — to contribute to their area of research and help advance science. Reviewers, already facing intense pressure to publish their own work and secure funding, may lack the time or motivation to dedicate the necessary effort to provide truly insightful feedback. This leads to superficial or low quality reviews, delays in publication, and a general sense of frustration among both authors and reviewers.

The problem is further exacerbated as a significant imbalance in the distribution of the peer-review effort across the scientific community — 20% of the researchers performed 69% to 94% of the reviews [23] — calls into question the sustainability of the peer-review system. Appropriate incentives for peer review are in urgent need to complete the feedback loop of the research ecosystem.

Recent attempts to patch the broken incentive structure of peer review, such as offering nominal monetary compensation or public name recognition, have proven largely ineffective because they fail to address the core issue: these rewards are disconnected from the metrics that actually matter in a researcher's career. A small honorarium or a "top reviewer" badge on a journal's website is a cosmetic fix that does not translate into the currency of academia. The critical decisions that shape a researcher's career — hiring, promotion, tenure, and even grant awards — are seldom, if ever, influenced by their peer review contributions. A tenure committee is far more concerned with a candidate's publication record in high-impact journals and their success in acquiring funding.

This creates a fundamental misalignment where an essential community service is treated as an unrewarded volunteer activity, separate from professional advancement. What is critically needed for peer review, therefore, is not more peripheral rewards, but a new type of incentives that are intrinsically woven into a researcher's professional development — a system where high-quality contributions to peer review directly and visibly enhance a researcher's reputation and career opportunities within the academic community.

A Myriad of Other Issues:

A number of issues in peer review have already been presented above such as its ineffectiveness, low quality, failure in detection of errors, fraud, and plagiarism, conservative bias against innovation, and lack of genuine incentives. However, there are many more issues that need to be addressed in the current system.

The peer review process is rife with a host of other biases that judge the researcher rather than the research. Prestige bias, often called the “halo effect,” is a pervasive issue where work from a well-known researcher or a top-tier institution receives a more charitable review, while the same work from a lesser-known individual or institution is scrutinized far more harshly. Closely related is network bias, where reviewers may favor or unfairly critique manuscripts from colleagues, former students, or academic rivals within their social or professional circles. Personal biases, both conscious and unconscious, can also play a significant role, as can broader social and cultural biases against a researcher’s gender, ethnicity, nationality, or native language. The cumulative effect of these prejudices undermines the core principle of meritocracy, shifting the focus elsewhere.

The very structure of the traditional review process creates further vulnerabilities that compromise its integrity and reliability. Its largely opaque and closed nature is a primary concern, as it shields reviewers from accountability, allowing for unsubstantiated, harsh, or abusive comments to be delivered without consequence. Authors often receive limited feedback, with little opportunity to engage in a meaningful dialogue with reviewers, especially for funding reviews. Furthermore, the reliance on a small sample size, typically just two to five reviewers, introduces significant statistical randomness and inconsistency. The fate of manuscript can hinge on the luck of the draw, as one set of reviewers may accept a paper that another set would reject based on their unique perspectives or moods.

In its most egregious forms, this closed system can enable outright unethical behaviors, such as reviewers deliberately delaying a competitor’s publication or, in the worst cases, plagiarizing ideas and data from the very manuscript they were entrusted to evaluate. This combination of structural flaws and potential for abuse renders the system not just biased, but also fundamentally unreliable, unaccountable, and susceptible to corruption.

The recent emergence of open and semi-open peer review platforms is a commendable step towards addressing the chronic lack of transparency and accountability in scholarly publishing. However, these practices alone are not a panacea for solving the problem completely because they are deeply entangled with the more fundamental issues such as misaligned incentives and conflict of interest in fierce competition. Simply making a review public does not magically make a largely unrewarded activity more reliable in a failed system. Moreover, introducing transparency into a fiercely competitive environment can create its own set of challenges and concerns. Junior researchers may fear offering honest, critical feedback on the work of senior figures, fearing retaliation, while others might use the open forum to strategically undermine academic rivals. It may be harder to find qualified reviewers as some may be less inclined to participate in open peer review. The removal of anonymity could potentially reintroduce or exacerbate many biases, especially the conservative bias that blocks innovative ideas, due to groupthink or herd mentality [24]. Therefore, without a holistic, structural change that fundamentally redefines a researcher's role and rewards their contributions to the community, open review becomes little more than a transparent window into the same flawed system. The situation will not be fundamentally altered until the very incentives that govern academic careers are rebuilt from the ground up.

2.2 "Publish or Perish" Dilemma

Fueled by ill-motivated competition, the extreme pressure to "publish or perish" has pushed the academic publishing system, already weakened by a flawed peer-review process as discussed above, toward an irreparable breakdown. It is a system now driven by profit, prestige, and perverse incentives rather than the genuine advancement of science, often at the expense of research quality and accessibility.

Explosion of Low-Quality Research:
At the heart of the systemic failure is the pervasive "publish or perish" culture in research communities, where a researcher's career advancement, tenure, and funding are tied directly to their publication output that is often ill-evaluated. This intense pressure fundamentally shifts the academic focus from quality to quantity, incentivizing the pursuit of safe, incremental findings over ambitious, high-risk research that could lead to genuine breakthroughs. Eventually the pressure could foster an extremely detrimental environment where scientific misconduct becomes a tempting shortcut, even leading to the replication crisis in several research fields [25].

The "publish or perish" culture, fueled by the emphasis on publication quantity and journal prestige, incentivizes researchers to produce a large volume of publications, often at the expense of quality. This leads to an overwhelming amount of research being published, much of which is incremental, repetitive, or of limited scientific value if not fraudulent. This explosion of low-quality research not only wastes valuable resources (reviewer time, editorial effort, reader time, and publication costs) but also makes it increasingly difficult for researchers to keep up with the relevant literature and identify truly significant findings buried in the enormous noise.

Impact Factor Frenzy and Distorted Citation Metrics:
The breakdown of the traditional peer review process has also promoted the widespread use of simplistic metrics like journal impact factors and citations that were initially intended to provide more objective evaluations. The "impact factor" of a journal — a measure of how often its articles are cited — has become a dominant, and deeply flawed, metric for

evaluating research quality and researcher prestige. This “impact factor frenzy” prompts researchers to become overly preoccupied with publishing in high-impact journals, leading to a hyper-competitive environment that aggravates the “publish or perish” culture. It also encourages journals to prioritize publishing articles that are likely to be highly cited, even if those articles are not necessarily the most groundbreaking or methodologically sound.

Flawed citation metrics rely on simplistic, unreliable, and easily manipulated citation counts instead of directly evaluating the scientific content. These metrics fail to accurately reflect research quality and are susceptible to gaming and bias. The impact factor, if not manipulated, represents more or less a long-term statistical trend of a journal’s performance within its field. However, it is inappropriate to use it for judging the quality of individual papers, even in scenarios without abuse. For example, a select group of reviewers and editors often determine in a mostly random or biased way which papers will be published in a prestigious journal; these papers could subsequently receive more citations than their counterparts published in lesser-known journals simply because of the prestige and exposure to a wider audience; some of the citations could be due to flaws of the paper (especially those published in top journals) that others must cite to point out. Studies have found that nonreplicable papers are cited as well as replicable ones [26], and could be ironically more, even after the publication of the failed replication [27].

Paywalls and the Privatization of Public Knowledge:
A significant portion of scientific research, particularly in basic research fields, is funded by public money — taxpayer dollars. Yet, the results of this research are often locked behind expensive journal paywalls, accessible only to those affiliated with institutions that can afford hefty subscription fees. This privatization of public knowledge is not only ethically questionable but also profoundly inefficient, limiting access to crucial information for researchers, policymakers, and the public alike.

While the recent push toward Open Access (OA) models appears to be a solution, it has largely been an isolated step that fails to address the underlying issues. Instead of eliminating the financial barrier, many OA systems simply shift it, replacing “pay-to-read” subscriptions with “pay-to-publish” Article Processing Charges (APCs). This model creates a new form of inequity, disadvantaging researchers from less-funded institutions, and has inadvertently fueled the rise of predatory journals that feed on APCs. These opportunistic publishers exploit the author-pays system by offering easy publication for a fee, polluting the scientific record with poor-quality work and proving that merely changing who pays does not solve the core problem of a profit-driven industry.

Perverse Incentives Shadowing Publication:
Today many publication services have become the most shameful brokers, making huge profits while adding little value to the final products — publications. They charge the pubic

to read or researchers to publish, get experts to review papers for free, and create a false impression of the validity of published work. Together, they have helped hyping rampant perverse incentives: impact factor chasing, citation metrics-based evaluation, publish or perish, quantity over quality, popularity over originality, positive results over negative/null findings, etc. Do we actually need them at all? In the internet era, none of them are necessary. All scholarly publications can be hosted on an online eprint service with minimal cost, but the entire incentive structure must be overhauled for this to work.

For original research, scientific merit should be the sole motivation for a researcher to publish a paper and the sole criterion by which a reviewer judges its quality. Quality should always triumph over quantity in publication. In light of the complexity in today's research enterprise, there are technical issues that should be resolved for incentives in publication. For example, larger collaborations result in longer author lists, endangering proper merit allocation and recognition of individual authors' contributions. Besides original research, how should we evaluate other types of publications (e.g., review papers, reports, and comments), and how should we reward these contributions?

2.3 Allocation Challenges in Funding and Other Resources

While the flaws of peer review significantly impact funding decisions, the problems within the funding landscape itself extend beyond the shortcomings of the review process, resulting in a system that favors incrementalism over innovation. Both governmental funding agencies and private foundations, despite their stated goals, often operate in ways that stifle innovation and perpetuate a culture of risk aversion.

Neglect of High-Risk, High-Reward Research:
Government funding agencies, accountable to taxpayers and subject to political pressures, are often driven by a need to demonstrate short-term impact and tangible results. This leads to a strong preference for funding research projects that are likely to yield predictable outcomes within a relatively short timeframe. Truly transformative research, which by its nature is often high-risk and may not produce immediate, demonstrable results, is often overlooked or underfunded. This risk aversion creates a systemic bias against the very kind of breakthroughs that we need the most.

While private foundations often express a commitment to supporting high-risk, high-reward research, their actual funding practices often fall short of this ideal. Many foundations, lacking the internal expertise to evaluate truly novel ideas, rely on the same flawed peer review processes used by government agencies. This can lead to a situation where foundations essentially "double down" on the biases of the existing system, funding projects that are deemed "safe" by traditional standards but lack the potential for truly disruptive impact. They often end up supporting second-rate, low-risk projects that were not chosen by governmental funding.

The result is that the current funding system provides inadequate support for researchers, especially those in their early careers, who are pursuing unconventional, high-risk ideas that could potentially drive the next generation of scientific breakthroughs. Tragically, few of these young independent researchers — supposedly the "scientific start-ups" [5] — can survive the current system. The rare few who do are often left still struggling for survival and starved for resources. Their capacity for innovation is directly hindered, while established research groups, focused on safer, mainstream science, continue to receive the lion's share of funding.

Entrepreneur-like Investigators:
In many modern scientific fields, the role of a principal investigator (PI) in a funded project has undergone a dramatic transformation, shifting from a primary focus on research to a role that closely resembles that of a business entrepreneur. This shift is particularly evident in fields defined by fierce competition and expensive, large-scale, or equipment-intensive research that requires substantial funding. The relentless cycle of grant applications, progress reporting, financial oversight, and personnel management, and other bureaucratic tasks consumes a vast portion of a PI's time and intellectual energy. PIs are effectively the CEOs of small research enterprises, tasked with securing "venture capital" (grants), managing the "operations", and ensuring their team's productivity, all while navigating a highly competitive market for growth and recognition.

While this entrepreneurial model is often necessary for survival in the current system, its consequences for scientific innovation are profoundly negative. First, it fundamentally defeats the PI's primary role as a hands-on, innovative researcher. It is not uncommon for established PIs to spend nearly half of their effort on these administrative tasks [28], pulling them away from the lab bench, from deep, creative thinking, and from the actual process of discovery.

More dangerously, this model fosters a "winner-take-all" environment that can lead to a monopoly of resources. The most successful "entrepreneurs" build large, well-funded laboratories that can dominate a subfield, controlling access to critical equipment and intellectual territory. This consolidation of resources can inadvertently block further innovation by making it exceedingly difficult for smaller, more agile groups with potentially disruptive ideas to secure funding or compete, creating a system that favors incumbents over the next wave of scientific breakthroughs.

A Wasteful Wrong-headed Random System:
With its many problems in the current system (including the repeatedly discussed issues of peer review), the modern funding process has devolved into a colossal, wrong-headed, and wasteful endeavor that often hinders more than it helps. The sheer time and effort

invested by the entire community are staggering. The economic cost is perverse; studies have shown that for some grant programs, the collective cost of the application and review process can actually surpass the total amount of funds being awarded [29]. This immense waste is a direct result of fierce competition fueled by chronically high rejection rates. The process is also agonizingly long, often taking many months, if not over a year, from submission to decision. In fast-moving fields, a research project's original, innovative goals can become outdated or less relevant by the time funding finally materializes, if it ever does.

Beyond its inefficiency, the system is plagued by instability and an inherent randomness that undermines genuine scientific planning. Funding decisions, despite the exhaustive review process, have been shown to be notoriously unreliable, with little agreement between different reviewers evaluating the same proposal, suggesting the outcome is more akin to a lottery than a meritocratic selection [30]. Researchers may face constant financial precarity due to unpredictable funding gaps, the whims of political turmoil, and the pervasive tyranny of short-term funding cycles. Grants awarded for one to three years are fundamentally mismatched with the much longer timelines often required to make groundbreaking discoveries. This forces scientists into an endless, soul-crushing loop of grant applications, spending more time writing about the science they want to do than actually doing it, and going after more grants than they need or taking the constant risk that a single failed grant could end their career.

Finally, the entire structure has become increasingly bureaucratic and opaque, fostering monopolies of thought and resources. The growing bureaucratization, especially associated with "Big Science," adds layers of administrative burden and institutional barriers that essentially prevent fair competition for funding [31]. Funding decisions are often delivered from a black box, with little to no meaningful feedback or opportunity for dialogue between researchers and the agencies; it is a one-way communication channel devoid of discussion or exchange with the reviewers. This opacity fuels a vicious cycle of resource consolidation. Fields that are already well-funded attract more talent and build larger communities, which in turn gives them greater lobbying power to secure even more funding. This starves emerging or less-fashionable research directions of the resources needed to explore new frontiers, effectively blocking innovation and forcing the direction of science down a few well-trodden, monopolistic paths.

2.4 Tenure Trap and Postdoc Predicament

The academic career structure including the tenure system, ostensibly fosters intellectual exploration with academic freedom and the long-term prosperity of research, but it often functions as a perverse system that rewards conformity over creativity. It creates structural malfunctions and disincentives that hinder innovation and limit the potential of researchers, particularly at the most crucial early stages of their careers.

Local Decisions and Global Consequences:
The tenure system, intended to provide academic freedom and job security, has become problematic in the process itself, where local decisions have profound, global consequences. Hiring and tenure decisions are typically made within individual departments or institutions. While this localized approach might seem sensible, it often lacks the necessary breadth of expertise to properly evaluate researchers in specialized fields, especially in less-equipped institutions. Modern science is increasingly professionalized and complex, and a small group of faculty within a single department may not have the necessary knowledge to assess the true merit and potential impact of a candidate's work. Faced with this limited expertise, committees often default to simplistic and flawed proxies for merit in evaluation of a candidate, such as their capacity to attract funding and their record of publishing in journals with high impact factors. This creates a system where an evaluation that should ideally be conducted by the entire scientific community is instead handled by a small, often ill-equipped group, with ramifications that ripple across the entire research landscape.

Illusion of Meritocracy:
This reliance on flawed metrics creates a mere illusion of meritocracy, opening the door for factors unrelated to scientific merit to dictate career outcomes. Beyond the lack of expertise, tenure decisions are notoriously susceptible to bias, internal politics, and other social factors [12]. Personal relationships, departmental priorities, and even unconscious biases can influence hiring and promotion decisions, making the system far from a true meritocracy. This lack of objectivity undermines fairness and creates a climate of uncertainty and cynicism, discouraging researchers from pursuing unconventional or challenging research paths that might not align with the department's prevailing interests or political dynamics.

Protection or Obstruction?:
Academic freedom should be protected for everyone in the research community including students, postdocs, and other researchers, not just tenured members. Ironically, the system fails to protect those who need it most, while empowering the tenured to become potential obstructions. As a matter of fact, it is young and non-tenured researchers who are the most vulnerable and in the greatest need of protection [32]. Even worse, the flawed tenure system has created entrenched tribalism and hierarchies that discourage free exploration and risk-taking. Tenured professors, who are often decades into their careers and deeply invested in the prevailing paradigms, may be less inclined to embrace radical new ideas, especially if those ideas challenge their own established work. They may even actively block the acceptance of disruptive concepts from the next generation

of researchers. This “Planck’s Principle” effect, where new scientific truths only triumph as older generations of scientists pass away, is a stark reality that slows down the natural course of scientific revolution.

Tenure Pressure and the Conformity Trap:
The intense pressure to secure tenure, with its emphasis on publication quantity in high-impact journals and grant success, forces many young researchers to adopt a conservative strategy in their work. They are incentivized to pursue “safe” research within established paradigms, avoiding the kind of bold, unconventional ideas that might challenge the status quo but also carry a higher risk of rejection. This “conformity trap” stifles creativity at its source, filtering out potentially transformative discoveries before they even have a chance to be explored.

Lack of Scientific Startups:
Consequently, the system fails to foster true scientific startups [5], leaving postdocs in a state of predicament. Rather than serving as a dynamic incubator for innovation, the postdoctoral phase has become a precarious and exploitative trap. Postdocs are typically on short-term contracts, lacking the independence or security to pursue their own novel ideas, and are instead beholden to the research agenda of their supervisors. This model stands in stark contrast to the startup culture in the capitalist economy, which thrives on empowering new talent. The lack of autonomy and stability for early career researchers jeopardizes a crucial segment of the research workforce that is best positioned to provide the diversity of thought necessary for scientific progress.

Misaligned Incentives:
Ultimately, these dysfunctions stem from a profound and systemic misalignment of incentives within academia. Rather than rewarding genuine academic achievements, the current system prioritizes the ability to attract external funding and publish in prestigious venues. This creates a cycle where institutions seek to hire individuals who can secure large grants, who in turn are pressured to chase funding trends rather than follow their intellectual curiosity. As a result, the academic landscape is increasingly dominated by opportunists who view research as a means to an end, rather than genuine scholars. Researchers are also often judged by, and thus motivated to produce, the quantity rather than the quality of their work. Even when the emphasis is on quality, it is often measured by superficial metrics like citations rather than the true intrinsic value of the work, which can only be truly recognized by the collective judgment of the entire community over time.

2.5 Inherent Resistance to New Ideas

The history of science is replete with groundbreaking discoveries that were initially met with resistance, skepticism, or outright dismissal. This phenomenon is so common that it has been studied under various names, including resisted discovery [33], delayed recognition [34, 35], premature discovery [36], late-bloomer [37], and “sleeping beauty” [38].

Obviously, the possible unethical or abusive behavior in the current system can cause resistance to new ideas. Other cultural and social sources of resistance to new ideas have been discussed by Barber [33], including substantive concepts (established traditional theories and beliefs), methodological conceptions (established methods and models), religious ideas (and possibly other ideological, philosophical, and even political conceptions), professional standing, professional specialization, and institutions and seniority (related to authority and monopoly effects). Understanding the roots of this resistance is crucial, as it reveals deep-seated, structural impediments to innovation that go far beyond the simple superficial social behavior.

Science, by its nature, is conservative; its power lies in building upon a stable foundation of established knowledge. However, this inherent conservatism is the primary source of resistance to new ideas in the social structures of science itself. This resistance manifests primarily through three interconnected factors: the inertia of prevailing paradigms, the prematurity of the new idea itself, and obstruction by authoritative figures, particularly under academic monopolies. Advancing a new idea is like pulling an object forward on a surface. Prematurity is like the perceived weakness of the pulling rope. Paradigm inertia is the immense friction from the surface of accepted knowledge. Authoritative obstruction, often stemming from monopolies, acts like bumps, traps, or defects on that surface, capable of making any forward progress futile. Concrete examples of these obstructions are shown in Barber’s classic analysis [33].

Paradigm Inertia: As Thomas Kuhn famously described, most scientists, most of the time, work within the domain of “normal science” — solving puzzles under and in compliance with the established knowledge framework [1]. This is especially true for mature branches of science or modern sciences with entrenched paradigms. Many studies that claim to be exploratory or innovational actually mostly follow established approaches and guidelines. Truly transformational or paradigm-shifting discoveries are very rare and are thus inevitably met with resistance before they could be acknowledged. The more revolutionary the idea, the greater the resistance it will face. Combating this inertia requires a community that not only tolerates but also actively encourages a diversity of thought, preventing academic monopolies. The established framework is hard to break without an open-minded community. Modern specialization and required long and sophisticated trainings in research make it even harder. Therefore, the community should always welcome new, fresh minds and ideas, allowing exploration with maximum freedom to the extent possible.

Prematurity: Resistance can also stem from the prematurity of a discovery, where an idea is simply ahead of its time. This is not necessarily a malicious rejection but a practical one. A new concept at its nascent stage may lack the necessary evidentiary support, its potential applications or impact may not yet be visible, or the technological and mathematical tools required to test and develop it may not exist. The idea might be comprehensible only to a select few experts, failing to connect to the broader scientific picture. In these cases, the weakness is at the connection — the link between the new idea and the next practical steps of development is missing, causing the idea to lie dormant until the rest of the scientific development catches up. Recognizing this requires even greater tolerance and open-mindedness within the research community.

Authoritative Obstruction: It represents a more active form of resistance, especially when a disruptive idea does not reconcile with the current paradigm. In extreme cases, academic monopolies can exploit scientific skepticism to block or dismiss competing innovations. While healthy skepticism is vital, a truly scientific approach recognizes the potential of a nascent discovery, provides enough support to allow for its development and rigorous testing, and only turns to more destructive criticism if it fails verification in the end. The monopolistic approach, in contrast, is to smother a new idea at its inception, denying it any chance to survive. Therefore, to fight against this inherent resistance, our entire community must adopt a new ethos: one of constructive, supportive skepticism in a discovery's early stages, which only later transitions to more rigorous, falsifying criticism once the idea has had a fair chance to mature.

Of all basic research fields, mathematics is uniquely positioned to foster new ideas. Its evaluation is more straightforward — a proof is either correct or not — and its diverse problem and solution landscape creates a win-win environment where multiple paradigms can coexist and succeed and paradigm destruction is rare. In contrast, a natural science field, such as physics, is characterized by a single dominant paradigm, particularly during a period of "normal science". The verification process here is far more complex and often prolonged, and researchers frequently engage in fierce, zero-sum competition where one researcher's success can mean another's failure. The result is an ecosystem that is inherently more resistant to radical innovation.

2.6 The "Matthew Effect" and Academic Monopolies

Beyond the specific flaws in its various components, the research ecosystem is governed by a powerful, self-reinforcing dynamic known as the "Matthew Effect" [39]. This effect — where "the rich get richer and the poor get poorer" — describes how initial advantages compound over time, leading to a concentration of resources, recognition, and opportunities. In science, this means that researchers and institutions with established track records are disproportionately favored, creating a cycle where success begets more success. This effect, most obvious in mature fields, permeates all aspects of the ecosystem, from securing funding and publishing in high-impact journals to attracting top talent and winning prestigious awards. While rewarding success seems logical, the unchecked Matthew Effect inevitably leads to the formation of academic monopolies [5], which can cause knowledge homogenization and ultimately lead to the stagnation of science.

This phenomenon is a classic example of a positive feedback loop, which, without proper countermeasures, will always reinforce existing strengths and drive a system towards monopoly or singularity. Mathematically, this can be modeled as a simple exponential growth:

$$dP/dt = \lambda P, \quad (1)$$
$$P(t) = P(0)\exp(\lambda t), \quad (2)$$

where $P(t)$ represents accumulated advantage (such as power, fame, or resources) over time t (in units of years), and the positive feedback coefficient λ dictates the rate of growth that could depend on t in certain scenarios. A simple example illustrates its power: consider a rough model on personal fame over an active time span of 40 years. As shown in Table 1, assuming $P(0) = 10$, even a modest variation in the feedback coefficient λ from 0.1 to 0.5, giving a minuscule difference (between 11–16) in fame in the first year, can eventually result in a drastic difference between an ordinary person and a world-renowned celebrity. This demonstrates quantitatively how small initial advantages, when compounded exponentially, lead to vastly different outcomes in the end.

Table 1: Example of the positive feedback effect on personal fame over a 40-year period. This rough model assumes that the feedback coefficient λ is time-independent and initial fame is constrained within one's own family, i.e., $P(0) = 10$.

λ [yr^{-1}]	0.1	0.2	0.3	0.4	0.5
$P(40)$	546	3×10^4	1.6×10^6	8.9×10^7	4.9×10^9
Fame	ordinary	local	regional	national	world celebrity

Note that the product of λt plays a critical role in the behavior of $P(t)$. The tricky part of the exponential function, $\exp(\lambda t)$, is that it behaves like an exponential growth only when λt is significantly large; otherwise, it behaves more like a linear function when λ and/or t is small enough such that $\lambda t \ll 1$. This is especially important when considering the human lifespan or the time frame of any real-world system (i.e., t) is limited or finite.

In the context of scientific research, t and λ can be seen as representing the maturity and competitiveness of a field, respectively. In a nascent field, t is short enough that for any reasonable λ, the growth is basically linear. However, as a field matures and becomes more established (i.e., t increases), and competition intensifies (i.e., λ increases), the strengthened feedback loops can create the risk of a runaway explosion. While the exponential growth of intangible assets like fame may be relatively harmless, the same dynamic applied to tangible assets like funding, power, and access to other resources is deeply problematic. Such unrestricted growth leads directly to monopolies that can control the intellectual direction of a field and block competing innovations. It is therefore imperative that any healthy research ecosystem should have robust countervailing measures — akin to antitrust laws in an economy — to prevent the concentration of power and ensure that the P-value remains within reasonable limits.

The evidence of this monopolistic stagnation may already be upon us. Despite the exponential growth in publications, personnel, and funding across science, we are not seeing a commensurate rate of scientific progress. In fact, studies suggest the overall rate of progress is nearly constant, or even declining in mature fields like physics [40]. Is it possible that we are approaching a kind of developmental singularity, where the system has become so monolithic that its capacity for genuine innovation is collapsing under its own weight [41]? This troubling trend could be a clear warning sign that we are entering a dangerous phase of academic monopoly, one that requires immediate and systemic intervention.

2.7 Broken Feedback and Perverse Incentives

At its heart, science should be an engine of innovation, driven by a feedback system that rewards discovery and progress. However, the current ecosystem is defined by broken feedback and perverse incentives, creating an environment that often steers researchers away from groundbreaking work and towards behaviors that game the system. These misaligned incentives are a root cause of many of the crises discussed previously, including the failures of peer review and funding, the replication crisis, the proliferation of low-quality research, and the precarious career paths faced by young scientists [42].

The incentives in the current system are frequently implemented in the **wrong feedback loops**, promoting proxies for innovation rather than innovation itself. For instance, the “publish or perish” culture incentivizes the quantity of publications over their quality, leading to an exponential flood of low-quality papers. This creates a formidable background of noise, making it incredibly difficult for genuinely innovative research to receive the attention it deserves. Similarly, hinging tenure and promotion decisions on a researcher’s ability to secure external grants transforms principal investigators into entrepreneurs focused on business operations, rather than innovators diving deep into research problems. This not only diverts their intellectual energy but also encourages the consolidation of resources into large, established “businesses,” i.e., academic monopolies, which can stifle nimble, exploratory science.

Many perverse incentives, whether implemented deliberately or having emerged inadvertently, are **corrupting the entire system**. Funding agencies, in practice, overwhelmingly favor mainstream proposals, leaving truly high-risk, high-reward projects with little to no support. Shortsighted evaluation metrics compel researchers to pursue projects that yield quick, publishable results, which can encourage corner-cutting and, in extreme cases, lead to outright fraud. The disproportionate prestige awarded to publications in high-impact journals regardless of their true quality grants dominant publishers immense power to shape the direction of entire fields, creating a feedback loop where the journals, not the scientific community, dictate what research is considered important.

Furthermore, any incentive system based on **simplistic and flawed proxies for merit** — especially coarse metrics derived from journal impact factors and citations — is inherently vulnerable to gaming. According to Goodhart's law, when a measure becomes a target, it ceases to be a good measure. As competition intensifies, researchers quickly devise new strategies to manipulate these metrics, rendering them misleading and unsuitable as measures of genuine scientific contribution. The unfortunate outcome is a system where the most "successful" individuals are often not the most transformative researchers, but rather those who are most adept at exploiting the system's rules.

This erosion of meritocracy is compounded by the **absence of sufficient incentives in other crucial areas**, especially for indirect contributions to innovation such as evaluation of original research. This lack of incentives is most evident in the essential work of peer review, making it a constant struggle to recruit reviewers and sustain the quality of evaluation. Currently, there is no active mechanism to engage the entire community in these vital indirect research activities.

To rectify this broken system, we must **fundamentally rebuild our feedback mechanisms to truly foster innovation by connecting proper incentives to career advancement**. The new incentive structure must properly recognize and reward all contributions — both direct and indirect — that advance science. It should prioritize quality over quantity, actively support high-risk research, and involve the entire community in evaluation. While traditional forms of peer recognition like eponyms, prizes, and awards are valuable, they are far too selective to serve as a comprehensive incentive for the entire research body. What is required is a robust, rigorous, and gaming-resistant system — a new "system of coinage" for scientific contribution — that can be applied fairly and transparently across the entire community, ensuring that our incentives once again align with our ultimate goal of pursuing knowledge and innovation.

3 The Vision of a New Ecosystem (CORE)

To overcome the systemic flaws crippling the current research landscape, we need a fundamental paradigm shift — a transition to a Community-driven Open Research Ecosystem (CORE). This is not a matter of simply tweaking existing processes; it's about reimagining the entire research enterprise, from how research is conducted and evaluated to how it is disseminated and rewarded/funded. The foundation of this new paradigm is not simply some popular concept of "openness" or "collaboration" in the abstract, but a deeper, more essential basis: **the Diversity Principle**, as derived from the nature of our universe and the survival requirements for any resilient evolving complex system [41]. All the other principles and features of a CORE naturally stem from this fundamental Diversity Principle, which, as we will discuss in detail below, does not align exactly with its common usage in political or sociological discourse.

Before delving into a detailed discussion of this new system, let us first state the principle and unpack the vision embedded within its name — CORE:

- **The overarching principle is the Diversity Principle** — advocating for a merit-based system that constantly cultivates diverse ideas and directions to foster innovation.
- **Community-driven** — engaging the entire community so that participation is all-inclusive, voices are democratic, and diverse ideas and directions in research are preserved and actively promoted; also implying that it mirrors the structure of a healthy society with built-in monopoly-breaking measures against the top and a robust safety net for the bottom.
- **Open** — indicating an open-ended, open-minded, open-to-risk, and dynamically calibrated system that maintains transparency of the procedure and process while protecting each individual's will and privacy, constantly evolving to meet new challenges and resist gaming.
- **Research** — requiring scientific, rigorous, and merit-based ethos and approaches.
- **Ecosystem** — implementing healthy, self-correcting feedback loops and proper incentive mechanisms in a living, self-regulating system.

3.1 The Diversity Principle

The overarching principle for CORE is the Diversity Principle, a concept born from observations in the physical universe, life's evolution, and human civilization. It is not simply a call for social inclusion or diversity, but a scientific imperative for the long-term survival and advancement of any complex system.

Physical Origin:

The universe was born with an arrow of time, a broken time-reversal symmetry that drives all systems — from cosmos to life to human society — to evolve in a direction of increasing complexity. In particular, the evolution of the universe is making it richer in its contents and phenomena; the evolution of organisms yields more intricate lifeforms; and the evolution of human society demonstrates ever-advancing innovation and knowledge.

This time direction cultivates motivation and goals (that may change over time) for a given social system, driving it inherently and collectively towards desired complexity. In our economy, this is the creation of wealth; in science, it is the pursuit of innovation. While an individual's motivation or goal may diverge from one another, the collective one of a healthy system will eventually converge. Identifying this collective driving force is the first step in designing a strategy for a system to thrive. One might assume that the most direct route to the goal is a simple, merit-oriented system that picks the "best" path.

However, the universe is not that simple. Quantum physics reveals that the world is intrinsically indeterministic. As the quantum action principle, elegantly expressed in Feynman's path integration formalism, shows, nature does not follow a single, predefined optimal path; rather, it explores all possibilities to arrive at a probabilistic outcome [43]. The physical laws align perfectly with our experience in life and human society: there is no guaranteed "best" path to our goals and exploring a multitude of paths is essential.

Necessity of Diversity:
In an indeterministic world with a volatile environment, different attributes are needed at different times for the survival of a social system. There is no intrinsic or permanent superiority or inferiority for any given trait. The Diversity Principle recognizes the indispensable differences between individuals. Each individual, with their unique attributes, is a distinct possibility that makes evolution possible. Using a physics analogy, individuals are like independent paths in a path integral, not interchangeable, identical particles.

The optimal strategy for any resilient system, therefore, is to preserve the widest possible diversity of attributes — and even add more — to meet the unexpected challenges of the future. The history of life on Earth is a stark testament to this: species that lost their diversity, like dinosaurs who over-specialized in largeness, faced extinction when conditions changed.

Furthermore, this principle is inherently dynamic: an attribute that is advantageous today may be detrimental tomorrow. A gene that is currently unimportant or redundant may have been critical for survival in the past or could be in the future. Planck's principle in sociology of knowledge — science advances funeral by funeral — offers another example, showing how even a great scientist's admirable persistence can, over time, become an obstacle to the next generation of ideas.

For human civilization, the key to our long-term survival and progress is maintaining a wide diversity of traits, ideas, and approaches to meet unforeseen challenges. A healthy modern society must encourage individuals to pursue their unique interests and passions, provided they are not harmful to the common good, as these explorations are the very source of new, beneficial diversity. The more advanced our society becomes, the more we can and should encourage such efforts.

Applied to basic research, the Diversity Principle requires a full spectrum of ideas and talents. In particular, we need two distinct archetypes of researchers who occupy opposite ends of this spectrum: "birds," the visionaries who see the big picture, and "frogs," the detail-oriented technical experts who master the complexities of their specific niche [44]. Put simply, science needs both disruptive creators and meticulous developers to advance. Unfortunately, the visionary "birds", who are capable of overcoming academic tribalism and forging new paradigms, are becoming an increasingly endangered species in today's specialized world. This loss is particularly concerning because it is precisely our young researchers who possess the latent potential to become these visionaries, if only the environment would nurture it.

3.2 Architecture of the CORE Principle

The Diversity Principle is not a call for directionless chaos. It must be implemented through a carefully balanced architecture that guides the system toward progress while safeguarding its foundational diversity. This architecture rests on three pillars:

Meritocracy with Equal Opportunity (The Engine):
While fostering diversity is essential, it is also critical to prioritize the attributes that are best suited for further development at a given time. In other words, the system must recognize and reward merit to move forward. In biological evolution, nature selects for success through "survival of the fittest," and in classical physics, it is "survival of the stablest," as dictated by the principle of least action (classical action principle).

However, the quantum world offers a more nuanced yet powerful model. The quantum action principle reveals that stable outcomes are not a single, predetermined path but a probabilistic mixture of all possible configurations. Crucially, this principle provides a profound physical analogy for **equality of opportunity**. Every potential path is weighted with a phase factor of equal amplitude; each has an equal chance to contribute to the final result, even if most ultimately cancel out.

In a research ecosystem, this translates to a merit-based system that ensures equality of opportunity for all members in the community. Drawing again from the quantum analogy, every potential "path" (every researcher and every idea) is given an equal initial weighting and a fair chance to succeed or contribute to the final outcome. The challenge, therefore, is to design an evaluation system that can accurately account for a member's contributions to innovation, both direct and indirect, ensuring that success is determined solely by the quality of their work.

Monopoly Prevention (The Regulator):
The positive feedback loops inherent in any merit-based system can lead to a "winner-take-all" dynamic when unchecked, eventually leading to monopolies, as discussed above.

History and nature provide stark warnings against this. Species like the dinosaurs, which became too dominant, lost the diversity needed to survive environmental shifts. The lesson we learned from this is that the more powerful a system becomes, the more diversity it should keep and promote. Otherwise, the powerful self-reinforcing effect of positive feedback will quickly eliminate minor traits and strengthen the dominant one only leading to extinction or singularities in the end. Similarly, unregulated markets eventually foster monopolies that crush innovation and the economy. In human society, extremism, bias, and prejudice are social versions of this runaway feedback, suppressing minorities (hence diversity) and enforcing dangerous groupthink or monopolistic views.

In scientific research, this runaway dynamic can lead to academic monopolies of ideas, resources, and authority. These are just as dangerous as their economic counterparts, because they stifle competition, compel groupthink, and ultimately reduce the very diversity necessary for a healthy, evolving field. Therefore, in addition to community-based approaches of equal voice and opportunity and the like, a CORE must implement active anti-monopolistic measures. This includes rules to prevent any single person or group from dominating a research direction and, critically, dedicating a protected portion of resources to exploratory research — funding high-risk, high-reward projects that explicitly challenge the mainstream.

A Robust Safety Net (The Foundation):
The physical world is stable because its energy is bounded from below (cf. positive energy theorem in general relativity [45, 46, 47] and the existence of a ground (lowest-energy) state or vacuum state in any quantum system [48]). A resilient society requires a similar safety net to ensure its stability and preserve its diversity.

Depending on economic conditions, the society should guarantee a minimum living standard for everybody and reward innovation accordingly. This ensures that all human traits and talents are preserved and developed, as we never know which ones will be essential for our future.

Thanks to advancements in STEM, our society has achieved a level of production efficiency that has made resources abundant. We can, and therefore should, build a better safety net for everyone, providing true equal opportunity for each individual. Fewer and fewer people need to work in jobs directly related to our living conditions. We have the luxury of encouraging more people, especially young people to freely explore and pursue their individual goals.

In the research ecosystem, this means no qualified researcher should be allowed to fall through the cracks. A CORE must provide a minimum level of support for all its qualified members. This is especially critical for early-career researchers, who need long-term support and independence to pursue bold ideas without facing the constant threat of career extinction. This foundation is not a handout, but rather a strategic investment in our collective future.

The CORE Principle:
Therefore, to foster innovation in STEM and probably other creative endeavors, the CORE approach is a dynamic and balanced application of the Diversity Principle: building an ecosystem that promotes meritocracy and diversity, providing equal opportunity for all members in the entire community while simultaneously applying monopoly-breaking measures against the top and securing a safety net for the bottom.

3.3 The Feedback Loop: Incentives Tied to Career Progression

The entire CORE architecture is powered by a rebuilt feedback loop, driven by a new system of proper incentives. The key is to forge a direct, unbreakable link that connects a researcher's contributions to their career advancement.

In scientific research, it is more indirect and often delayed in feedback from scientific contributions to recognition (in the form of respect, status, and wealth that follows). Perverse incentives in the current system have made the situation worse. So proper timely incentives through well-designed feedback loops are critical to foster true innovation.

The first step is to recognize and reward two distinct but equally vital types of contributions: **direct contributions** to innovation (original research) and **indirect contributions** that support and sustain the research community (such as peer review, teaching, and mentoring). The evaluation of both types must involve the entire community and, critically, must be used to directly inform decisions on hiring, promotion, and role appointments.

Direct contributions, the tangible achievements of innovative research, should be assessed through an achievement evaluation system. This system's guiding principle must be quality over quantity. A rigorous, open evaluation process involving all community members, with constantly refined metrics, will ensure its accuracy and robustness. This community-wide dynamic approach is essential to counteract the risk of disruptive ideas being undervalued or rejected by dominant figures or prevailing paradigms.

Indirect contributions are the essential, yet chronically undervalued, labor that makes science possible. This includes critical evaluation work (comments, ratings, and reviews), educational contributions (textbooks and lectures), and a vast range of other activities such as maintaining equipment, organizing conferences, developing scientific software, administering facilities, writing pop-science articles, and so on [7]. Creating a system to properly categorize and credit these diverse contributions is a central challenge, and success here will be critical for defining a member's role and standing within the community.

This dual evaluation system must also navigate significant complexities. For collaborative work, we must devise sophisticated schemes to appropriately credit each individual, with different strategies for the two contribution types. The credit scheme for indirect contributions may be particularly tricky. Furthermore, we must acknowledge that some of the most profound indirect contributions are difficult to quantify, such as the role of a mentor who acts as an "evoker of excellence" or a "liberator of genius" in others — the talent scouts and catalysts of science [37].

An Achievement Level (AL) system for direct contributions and an Earned Credit Point (ECP) system for indirect ones, as detailed in the OePRESS model [7], provide a robust framework for establishing these feedback channels. The revolutionary step is not merely to create these systems, but to close the feedback loop by tying them directly to career outcomes. Active participation from hiring institutions and funding organizations will be critical for its success. The AL system should primarily determine a researcher's academic position and basic funding level, replacing the broken postdoc and tenure systems with a continuous, merit-based progression. The ECP system, in turn, should primarily determine a researcher's service, educational, and administrative roles. The future of scientific innovation hinges on the health of these new feedback mechanisms.

3.4 Derived Principles and Key Features

While the Diversity Principle is the fundamental axiom of a CORE, its practical implementation is guided by several familiar, derived principles. These tenets are evocative and useful, but they have their limitations. In any case of conflict, we must always return to the foundational Diversity Principle for guidance.

Democracy: A community-driven ecosystem requires democratic principles to prevent monopolies. Members must have an equal voice to freely comment on scientific contributions and activities, and their ratings and votes must carry equal weight. This ensures a broad base of evaluation. However, this democratic foundation must coexist with the necessary hierarchical structures of a merit-based system; it is about equal voice, not equal authority.

Equal Opportunity: This is the critical engine of a merit-based system. It guarantees each member a fair chance to succeed, allowing meritocracy to function properly. It stems directly from the Diversity Principle's recognition of individual uniqueness and is the well-spring of other values like fairness, justice, and anti-bias/prejudice rules. Critically, this must never be confused with the dangerously flawed idea of equality of outcome, which falsely assumes that all individuals are interchangeable and inevitably leads to a stagnant, moribund equilibrium.

Academic Freedom: True innovation requires the freedom to explore, question, and express diverse ideas. A CORE must fiercely protect academic freedom. While minimum standards must exist to prevent truly detrimental behavior (e.g., plagiarism, fraud, and other harms), all other activities and ideas should be allowed and tolerated, not suppressed through over-moderation or censorship, which occurs unfortunately too frequently today [49]. A direct consequence is that all meaningful contributions in a CORE are published at the sole discretion of their authors. This eliminates the "publish or perish" culture, ends the need for rejection based on perceived low quality, and minimizes censorship, transforming the ecosystem into one of trustworthy feedback and continuous improvement.

Open Science: As an explicit expression of its principles, a CORE embodies true open science. All phases of research, including not just the final product but also the reviews and evaluations, are recorded, preserved, and made transparently accessible. "Trade secrets" of the research process and critical evaluation, once passed down within elite circles, are shared with all members. This open access demystifies science for the next generation and makes the daunting task of finding intellectual gems within a vast literature a more manageable and fruitful endeavor.

Rigorous and Multi-Faceted Evaluation: A CORE's evaluation system is its central nervous system. To serve the Diversity Principle, it must be rigorous and multi-faceted, moving beyond the simplistic, gameable metrics of the past. The evaluation should faithfully and accurately reflect the value of original research, the potential of proposals for funding and other resources, and the quality of other activities. By considering a wide range of factors for all types of contributions, the system can recognize and reward a more diverse array of research outputs and other contributions. The new evaluation system is especially crucial for promoting high-risk, high-reward projects and empowering early-career researchers, who are often disadvantaged by ill-defined, conventional metrics.

Dynamic and Adaptive Nature: A CORE is not a static set of rules or principles but a living, dynamic system. The implementation of its core principles must evolve over time. The degree of anti-monopoly regulation, for example, will need to increase as a field matures. Similarly, the strength of the safety net for researchers at the bottom (especially in their early career) will depend on the economic prosperity of the surrounding society.

This adaptability also means the system's metrics must be dynamically calibrated. Constant refinement naturally defeats attempts at gaming and allows for the integration of new technologies, such as blockchain for authenticity and a decentralized system, and AI for pattern analysis and efficient, automated tasks.

A Self-Regulating Ecosystem: With these features in place, a CORE becomes a healthy, self-regulating ecosystem where individual success is perfectly aligned with the collective goal of advancing knowledge. The community itself monitors the system's health, ensuring that diversity is preserved and monopolies are prevented. The complete feedback loop — connecting rigorous evaluation directly to funding, hiring, and promotion — will foster sustained innovation for the foreseeable future. It becomes a system where content is produced with a free exploratory spirit, evaluated with genuine scholarship, recognized for career advancement of each member, and shared for the benefit of all.

3.5 Implementation of a CORE

For a detailed concrete blueprint of CORE, we refer readers to a recent proposal of Oe-PRESS [7]. Here in this section, we will just sketch the essential architectural framework required to implement a CORE without much specific details.

Foundational Infrastructure:
The ecosystem must be anchored by a unique identification system — CORE-ID — to properly accredit each member's contributions. This system must be interoperable with widely adopted open-ID standards, especially ORCID [50], to ensure seamless integration. This identity system would be the gateway to an open-source online platform and repository, which serves as the central hub for the community. This platform must be accessible to general public, participated by all members in the research community, and designed to document all phases of research activity — not just papers and proposals, but also the reviews, comments, and ratings that form the backbone of a rigorous, quantitative evaluation system. For resilience and transparency, it could be implemented as a distributed system using technologies like blockchain, and it must be constantly refined with new findings/understanding and new technologies.

The Dual Evaluation System:
At the heart of this platform are two interconnected evaluation systems, designed to recognize the full spectrum of scientific contributions. The system first categorizes contributions into primary or parent documents (the initial work) and derived or daughter contributions (the reviews, comments, and ratings that follow). Primary documents can be either direct or indirect in terms of their contribution to innovation and should be further categorized according to research branches and types, while derived contributions are all indirect. These are then assessed by:

- **The Achievement Level (AL) System:** This system is designed to evaluate a member's direct contributions to innovation with a strict emphasis on quality over quantity. Each researcher is assessed based on a limited number (e.g., five) of their most significant achievements. While a single paper's AL can be determined by its average community rating, members can also consolidate multiple works into a single "synthesized achievement" for evaluation. To prevent abuse, the score of a synthesized achievement would be capped. Critically, this system incorporates a high degree of tolerance for novel ideas. As is well known, potentially disruptive ideas may not be fully understood at the early stage by many people, even the entire community. Therefore, negative ratings are reserved only for scientifically detrimental work (e.g., fraud, plagiarism), while crackpot or fringe ideas should be rated near zero, protecting them from suppression while they mature.
- **The Earned Credit Point (ECP) System:** This is the sophisticated counterpart designed to value and reward the vast ecosystem of indirect contributions. The ECP system evaluates all the service and support activities — especially participation in the evaluation system itself — that are essential but currently undervalued. The reward structure is non-linear, designed to promote excellence while penalizing bad behavior. Its design must consider multiple factors, such as encouraging openness and timeliness, paying attention to high-quality work, and recognizing differences in various types of contributions across different fields, to create a nuanced and fair incentive structure.

Both systems need distinct credit allocation schemes for collaborative work. To encourage teamwork, the AL system would be non-conserving, allowing multiple authors to share the same high achievement. In contrast, the ECP system would be conserving, distributing a fixed number of credit points among contributors. In light of often-delayed recognition of new discoveries, phased evaluation should be considered, especially in the AL system. Most importantly, the metrics in both systems should constantly be refined and calibrated as necessary. The dynamic and adaptive features of the dual evaluation system, as well as its community-driven nature, are ideal for discouraging gaming.

Funding and Career Progression:
With this robust evaluation service in place, we can fundamentally transform how science is funded and how careers are built.

Diversified Funding: The rich quantitative data from a CORE's evaluation system enables a powerful diversification of funding, moving beyond the rigid, one-size-fits-all traditional approach. Funding agencies can adjust their parameters, creating distinct portfolios that balance scientific soundness, risk, and potential impact. This flexibility allows for the tailored support of a wide range of research projects and structures, from large-scale collaborations to individual solo researchers. Furthermore, this data-rich environment provides the rigorous foundation needed to confidently implement alternative funding models, such as "genius grants" for exceptional individuals, lottery-based funding for all solid proposals to combat bias, or direct, flexible support for researchers rather than specific projects.

High-Risk, High-Reward Projects: The idea of a dedicated funding mechanism for high-risk projects becomes viable. This would entail establishing some minimum scientific standards for initial screening to include unconventional ideas. Then, the focus would shift to a project's testability or feasibility and potential impact. To avoid the pitfall of funding "safe" projects, the system could use metrics like the variance in community rating scores where strong disagreement is a good indicator of a disruptive idea. To combat the inherent expert bias against paradigm-shifting ideas, the evaluation of a proposal's potential impact could crucially involve non-specialists from adjacent or even distant fields, akin to a "science court" [24].

A New Career Path: The results from the CORE evaluation system should become the primary basis for a member's position and role in the community, replacing the often biased and limited internal reviews of individual institutions. A new hiring mechanism must be established, featuring long-term support for early-career positions and an achievement-based promotion track that replaces the broken tenure system. All qualified members would be secured with a basic funding level commensurate with their achievements, empowering them to explore freely without jeopardizing their careers. Members would also advance in their roles and service positions in the community according to the quantified evaluation of their indirect contributions.

Financial Model:
A sustainable financial model would draw from organizations that benefit most from a CORE's evaluation service. In particular, hiring institutions and funding agencies would pay annual membership fees at different sponsorship levels. In return, they would be able to announce job openings, post calls for proposals, and invite community reviews on the CORE platform. The money institutions save from eliminating traditional journal subscription fees in the new system would be more than enough to cover the new membership fees. Additional revenue streams could come from donations, overlay journal services, and other value-added subscriptions.

Technological Advancement:
The platform should be extensible, enabling a plugin system for third-party developers to safely create and test new features, such as a collaborative environment, a new rating scheme, a different user interface layout, and so on. Furthermore, we must leverage powerful AI and other new technologies. AI has the potential to address many of the challenges associated with large-scale, community-driven evaluation systems while comple-

menting human judgment. Machine learning and AI can assist with initial screening, fraud and plagiarism checks, reviewer matching, and even identifying when a body of work on original research may warrant a new phase of evaluation. With the right oversight, AI can become a cornerstone of a more efficient and rigorous evaluation system, empowering researchers and accelerating scientific progress.

4 Concerns and Challenges

The transition to a Community-driven Open Research Ecosystem, while promising, is a monumental undertaking fraught with significant challenges. Acknowledging and proactively addressing these hurdles is essential for navigating the path from a compelling vision to a functional and sustainable reality.

The first and most formidable challenge is securing the commitment of the relevant organizations that form the bedrock of the scientific enterprise, especially institutions that hire researchers and agencies that provide funding. Their participation is indispensable; it is what makes the CORE financially sustainable and, more importantly, what closes the feedback loop, giving the new incentive systems genuine power. Without institutional adoption, the evaluation metrics of a CORE remain theoretical. A viable strategy may be to launch a powerful pilot program within a receptive sub-community, demonstrate its effectiveness on a smaller scale, and use that success to build momentum, gradually involving more researchers until it gains critical mass and wins support from the entire community.

While preventing monopolies is a core principle, implementing effective, fair, and non-bureaucratic measures poses a complex design challenge. What are the appropriate limits? For example, should funding for a single project be capped at a fixed percentage (e.g., 10%) of a field's total budget? Should there be a lifetime cap on the amount of funding an individual researcher can control? How should we structure access to major user facilities to prevent them from becoming the private domains of a few powerful groups — perhaps by rotating user access or prohibiting permanent experimental teams? One straightforward rule that could be implemented early is to limit the number of projects in which any single investigator can play a major role, thus distributing leadership opportunities more broadly.

Any system based on quantitative metrics will inevitably face concerns about its potential for gaming and abuse. This is a valid and critical challenge. Therefore, ensuring the fairness of the CORE's metrics and, crucially, building in mechanisms for their constant refinement, is of paramount importance. The metrics must be carefully designed to avoid unintended consequences, such as favoring shallow popularity over deep, rigorous work. This requires a robust, ongoing feedback mechanism where the entire community is involved in refining the rules.

The dual evaluation system, while robust in theory, presents its own set of practical challenges. For direct contributions, implementing a phased evaluation system may be necessary, as truly new ideas are often met with initial resistance and may only be recognized as valuable much later. How do we design a system that can re-evaluate work fairly as consensus shifts? For indirect contributions, the challenge lies in the sheer diversity of activities. How do we properly recognize and reward contributions like mentoring or community-building, whose value is immense but notoriously difficult to quantify? Ensuring that the evaluation system is perceived as fair across this wide spectrum of activities will be essential for its success.

The traditional system has systematically failed to support high-risk, high-reward projects. While a CORE provides the framework to change this, the practical implementation remains an untested frontier. How do we quantify the risk factor of such projects? How do we operationalize concepts like the “science court” [24] or effectively recruit and leverage non-experts from other fields to evaluate a proposal’s potential impact? These are open questions that can only be answered through careful experimentation within the new system.

No matter what system is adopted, there are issues that persist. Paradigm inertia and conservatism can only be overcome by a constant influx of fresh ideas and young talents into the community. Preserving such freshness in an ecosystem would always be a challenge. Even in a community-based system, biases such as those toward established figures or fashionable fields can persist. The architecture must include built-in mechanisms to actively detect, flag, and mitigate these biases to ensure fairness.

5 Conclusion and a Call to Action

The current research ecosystem is failing us. Its systemic flaws, especially on peer review with broken feedback loops and perverse incentives leading to academic monopolies, are not minor issues to be patched, but deep-seated problems requiring a complete overhaul. This paper has outlined a vision for that overhaul: a Community-driven Open Research Ecosystem (CORE), guided by the foundational Diversity Principle. This is not merely a new set of rules, but a new philosophy for how science should operate — one that is more resilient and aligned with the ultimate goal of advancing human knowledge.

The establishment of such a system will not be an overnight reform. It will be a challenging, iterative process. However, the path forward is clear: a real-world implementation must begin. A single discipline can serve as the crucible for this new model, proving its viability before wider adoption. A fundamental field like physics, which pioneered the preprint movement with arXiv.org, is one logical starting point, perhaps driven by a dedicated non-profit organization. Alternatively, a field with more urgent needs, such as the life sciences, might be more fertile ground. Their preprint services, bioRxiv.org and medRxiv.org, though started much later than arXiv.org, are already more modern and better positioned to integrate the community-driven features of a CORE.

The initiative need not be exclusively academic. A for-profit effort, perhaps from a tech startup or a major corporation, could be highly successful in more applied research areas, where a rigorous and unbiased evaluation service would be invaluable for talent recruitment, especially for smaller companies. Regardless of the starting point, the initial phase will be critical. Securing early adopters and providing clear incentives for participation will determine whether the nascent ecosystem thrives or falters.

Upon the initial success of this first system, it can serve as an adaptable and scalable model for other disciplines. What begins in one field can spread, evolve, and connect, eventually establishing a full and self-regulating ecosystem for the entire global research community. The challenges are significant, but the need is urgent, and the potential rewards are immeasurable. The time has come to stop lamenting the failures of the old system and start building the new one.

Acknowledgments

This work is supported in part by the faculty research support program at the University of Notre Dame.

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