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title: Decentralized science (DeSci) description: An overview of decentralized science on Ethereum lang: en template: use-cases emoji: ":microscope:" sidebarDepth: 2 image: ../../assets/future_transparent.png alt: "" summaryPoint1: A global, open alternative to the current scientific system. summaryPoint2: Technology that enables scientists to raise funding, run experiments, share data, distribute insights, and more. summaryPoint3: Builds on the open science movement.

What is decentralized science (DeSci)? {#what-is-desci}

Decentralized science (DeSci) is a movement that aims to build public infrastructure for funding, creating, reviewing, crediting, storing, and disseminating scientific knowledge fairly and equitably using the Web3 stack.

DeSci aims to create an ecosystem where scientists are incentivized to openly share their research and receive credit for their work while allowing anyone to access and contribute to the research easily. DeSci works off the idea that scientific knowledge should be accessible to everyone and that the process of scientific research should be transparent. DeSci is creating a more decentralized and distributed scientific research model, making it more resistant to censorship and control by central authorities. DeSci hopes to create an environment where new and unconventional ideas can flourish by decentralizing access to funding, scientific tools, and communication channels.

Decentralized science allows for more diverse funding sources (fromDAOs, quadratic donations to crowdfunding and more), more accessible data and methods, and by providing incentives for reproducibility.

Juan Benet - The DeSci Movement

How DeSci improves science {#desci-improves-science}

An incomplete list of key problems in science and how decentralized science can help to address these issues

| **Decentralized science** | **Traditional science** | | ---------- | ---------- | | Distribution of funds is determined by th public using mechanisms such as quadratic donations or DAOs. | Small, closed, centralized groups control the distribution of funds. | | You collaborate with peers from all over the globe in dynamic teams. | Funding organizations and home institutions limit your collaborations. | | Funding decisions are made online and transparently. New funding mechanisms are explored. | Funding decisions are made with a long turnaround time and limited transparency. Few funding mechanisms exist. | | Sharing laboratory services is made easier and more transparent using Web3 primitives. | Sharing laboratory resources is often slow and opaque. | | New models for publishing can be developed that use Web3 primitives for trust, transparency and universal access. | You publish through established pathways frequently acknowledged as inefficient, biased and exploitative. | | You can earn tokens and reputation for peer-reviewing work. | Your peer-review work is unpaid, benefiting for-profit publishers. | | You own the intellectual property (IP) you generate and distribute it according to transparent terms. | Your home institution owns the IP you generate. Access to the IP is not transparent. | | Sharing all of the research, including the data from unsuccessful efforts, by having all steps on-chain. | Publication bias means that researchers are more likely to share experiments that had successful results. |

Ethereum and DeSci {#ethereum-and-desci}

A decentralized science system will require robust security, minimal monetary and transaction costs, and a rich ecosystem for application development. Ethereum provides everything needed for building a decentralized science stack.

DeSci use cases {#use-cases}

DeSci is building the scientific toolset to onboard Web2 academia into the digital world. Below is a sampling of use cases that Web3 can offer to the scientific community.

Publishing {#publishing}

Science publishing is famously problematic because it is managed by publishing houses that rely upon free labor from scientists, reviewers, and editors to generate the papers but then charge exorbitant publishing fees. The public, who have

usually indirectly paid for the work and the publication costs through taxation, can often not access that same work without paying the publisher again. The total fees for publishing individual science papers are often five figures ($USD), undermining the whole concept of scientific knowledge as a public good while generating enormous profits for a small group of publishers.

Free and open-access platforms exist in the form of pre-print servers,such as ArXiv. However, these platforms lack quality control, anti-sybil mechanisms, and do not generally track article-level metrics, meaning they are usually only used to publicize work before submission to a traditional publisher. SciHub also makes published papers free to access, but not legally, and only after the publishers have already taken their payment and wrapped the work in strict copyright legislation. This leaves a critical gap for accessible science papers and data with an embedded legitimacy mechanism and incentive model. The tools for building such a system exist in Web3.

Reproducibility and replicability {#reproducibility-and-replicability}

Reproducibility and replicability are the foundations of quality scientific discovery.

- Reproducible results can be achieved multiple times in a row by the same team using the same methodology.
- Replicable results can be achieved by a different group using the same experimental setup.

New Web3-native tools can ensure that reproducibility and replicability are the basis of discovery. We can weave quality science into the technological fabric of academia. Web3 offers the ability to create attestations for each analysis component: the raw data, the computational engine, and the application result. The beauty of consensus systems is that when a trusted network is created for maintaining these components, each network participant can be responsible for reproducing the calculation and validating each result.

Funding {#funding}

The current standard model for funding science is that individuals or groups of scientists make written applications to a funding agency. A small panel of trusted individuals score the applications and then interview candidates before awarding funds to a small portion of applicants. Aside from creating bottlenecks that lead to sometimes years of waiting time between applying for and receiving a grant, this model is known to be highly vulnerable to the biases, self-interests and politics of the review panel.

Studies have shown that grant review panels do a poor job of selecting high-quality proposals as the same proposals given to different panels have wildly different outcomes. As funding has become more scarce, it has concentrated into a smaller pool of more senior researchers with more intellectually conservative projects. The effect has created a hyper-competitive funding landscape, entrenching perverse incentives and stifling innovation.

Web3 has the potential to disrupt this broken funding model by experimenting with different incentive models developed by DAOs and Web3 broadly. Retroactive public goods funding, quadratic funding, DAO governance and tokenized incentive structures are some of the Web3 tools that could revolutionize science funding.

IP ownership and development {#ip-ownership}

Intellectual property (IP) is a big problem in traditional science: from being stuck in universities or unused in biotechs, to being notoriously hard to value. However, ownership of digital assets (such as scientific data or articles) is something Web3 does exceptionally well using non-fungible tokens (NFTs).

In the same way that NFTs can pass revenue for future transactions back to the original creator, you can establish transparent value attribution chains to reward researchers, governing bodies (like DAOs), or even the subjects whose data is collected.

IP-NFTs can also function as a key to a decentralized data repository of the research experiments being undertaken, and plug into NFT and DeFi financialization (from fractionalization to lending pools and value appraisal). It also allows natively on-chain entities such as DAOs like VitaDAO to conduct research directly on-chain. The advent of non-transferable"soulbound" tokens may also play an important role in DeSci by allowing individuals to prove their experience and credentials linked to their Ethereum address.

Data storage, access and architecture {#data-storage}

Scientific data can be made vastly more accessible using Web3 patterns, and distributed storage enables research to survive cataclysmic events.

The starting point must be a system accessible by any decentralized identity holding the proper verifiable credentials. This allows sensitive data to be securely replicated by trusted parties, enabling redundancy and censorship resistance, reproduction of results, and even the ability for multiple parties to collaborate and add new data to the dataset. Confidential computing methods like compute-to-data provide alternative access mechanisms to raw data replication, creating Trusted Research Environments for the most sensitive data. Trusted Research Environments have been cited by the NHS as a future-facing solution to data privacy and collaboration by creating an ecosystem where researchers can securely work with data on-site using standardized environments for sharing code and practices.

Flexible Web3 data solutions support the scenarios above and provide the foundation for truly Open Science, where researchers can create public goods without access permissions or fees. Web3 public data solutions such as IPFS, Arweave and Filecoin are optimized for decentralization. dClimate, for example, provides universal access to climate and weather data, including from weather stations and predictive climate models.

Get involved {#get-involved}

Explore projects and join the DeSci community.

- DeSci.Global: global events and meetup calendar
- Blockchain for Science Telegram
- Molecule: Fund and get funded for your research projects
- VitaDAO: receive funding through sponsored research agreements for longevity research
- ResearchHub: post a scientific result and engage in a conversation with peers
- LabDAO: fold a protein in-silico
- dClimate API: query climate data collected by a decentralized community
- DeSci Foundation: DeSci publishing tool builder
- DeSci.World: one-stop shop for users to view, engage with decentralized science
- Fleming Protocol: open-source data economy that fuels collaborative biomedical discovery
- OceanDAO: DAO governed funding for data-related science
- Opscientia: open decentralized science workflows
- LabDAO: fold a protein in-silico
- Bio.xyz: get funded for your biotech DAO or desci project
- ResearchHub: post a scientific result and engage in a conversation with peers
- VitaDAO: receive funding through sponsored research agreements for longevity research
- Fleming Protocol: open-source data economy that fuels collaborative biomedical discovery
- Active Inference Lab
- CureDAO: Community-Owned Precision Health Platform
- IdeaMarkets: enabling decentralized scientific credibility
- DeSci Labs

We welcome suggestions for new projects to list - please look at ourlisting policy to get started!

Further reading {#further-reading}

- DeSci Wiki by Jocelynn Pearl and Ultrarare
- A guide to decentralized biotech by Jocelynn Pearl for a16z future
- The case for DeSci
- Guide to DeSci
- Decentralized science resources
- Molecule's Biopharma IP-NFTs - A Technical Description
- Building Trustless Systems of Science by Jon Starr
- The Emergence of Biotech DAOs
- Paul Kohlhaas - DeSci: The Future of Decentralized Science (podcast)
- An Active Inference Ontology for Decentralized Science: from Situated Sensemaking to the Epistemic Commons
- DeSci: The Future of Research by Samuel Akinosho
- Science Funding (Epilogue: DeSci and new crypto primitives) by Nadia
- Decentralisation is Disrupting Drug Development

Videos {#videos}

- What's Decentralized Science?
- Conversation between Vitalik Buterin and the scientist Aubrey de Grey about the intersection of longevity research and crypto
- Scientific Publishing Is Broken. Can Web3 Fix It?
- Juan Benet - DeSci, Independent Labs, & Large Scale Data Science
- Sebastian Brunemeier - How DeSci Can Transform Biomedical Research & Venture Capital