FLYFOUNDRY PROTOCOL · WHITEPAPER V1.0

From Connectome to On-chain Life

An Executable Research and Manufacturing Protocol for Open Neuroscience

The next open-science network should not only store papers. It should execute hypotheses.

20 September 2026

BNB Chain · Reward Token: FLYF

Phase 1 test environment live

WHITEPAPER MAP

A Protocol Thesis for On-chain Neuroscience

Scientific data becomes provenance.
Behavior becomes executable.
Circuits become ownable.
Experiments become replayable.

Phase 1 is intentionally simple: acquire Materials, load a Blueprint, run it for free, ECLOSE, burn, receive a Circuit, and participate in Mining.

The whitepaper, however, is about a larger thesis: once connectomes become public digital infrastructure, can parts of neuroscience become public, executable, verifiable, and composable network objects?

Contents

1. Executive Thesis

Over the past several decades, neuroscience has progressively turned the nervous system into something that can be represented digitally: cell types, neuronal morphology, synaptic connectivity, and eventually complete connectomes. MaleCNS v1.0, released in 2026, covers the complete adult male *Drosophila* central nervous system - including the brain, optic lobes, ventral nerve cord, and the connections through the neck - and provides neuron annotations, neurotransmitter predictions, connectivity weights, skeletons, and synapse-level data.[1][2]

That creates a new question:

Once a nervous system can be represented as a digital structure, can behavioral hypotheses, neural circuits, computational models, and experimental results also become executable, verifiable, reproducible, and composable digital objects?

FlyFoundry's long-term answer is yes.

FlyFoundry aims to build an **On-chain Neural Research & Manufacturing Protocol** in which:

- connectomes become traceable scientific substrates;
- behavioral hypotheses become versioned Behavior Specs;
- neural circuits become executable Circuits;
- experimental results become replayable protocol facts;
- research contributions gain public provenance, ownership, and incentives;
- multiple Circuits can eventually compose into Digital Organisms with state, memory, and life cycles.

Phase 1 deliberately begins with simple Boolean neural logic. This is not because biological nervous systems are simple. It is because an open protocol first needs a minimal computational primitive that anyone can verify, any compatible client can replay, and ordinary users can understand.

FlyFoundry begins with the simplest behavior circuits. Its longer-term goal is more ambitious:

> **Move parts of neuroscience from descriptions in papers toward experiments that can be executed on a public network.**

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2. Why Now

2.1 Connectomes are becoming infrastructure

Connectomics is moving from a scarce research output toward infrastructure that software can query directly.

MaleCNS v1.0 was released in June 2026, with the complete study published in September 2026. The public data contains approximately 166,700 neurons and includes a full neuron-to-neuron connectivity graph, annotations, neurotransmitter predictions, and downloadable skeletons. MaleCNS data is released under CC-BY.[1][2][3]

The importance of this dataset is not simply that it is a larger map. It allows sensory-to-motor tracing, brain-to-nerve-cord analysis, and behavior-related circuit investigation to operate on a common digital substrate.[3]

2.2 Connectomes are becoming executable

Connectome data is no longer useful only for visualization. Research has shown that connectivity weights and neurotransmitter identity can be incorporated into relatively simple leaky integrate-and-fire models that predict aspects of *Drosophila* sensorimotor behavior and can subsequently be tested experimentally.[4]

This points toward an important direction:

> **A connectome can evolve from a wiring diagram into a computational substrate.**

FlyFoundry does not claim that Phase 1 is a whole-brain simulation. Genesis deliberately uses a simplified, fully deterministic neural-logic abstraction. Over time, higher-fidelity models, offline simulation, verifiable computation, and experimental data can be connected to the same provenance and ownership layer.

2.3 Blockchains can become a research coordination layer

Blockchains are not optimized for high-performance scientific simulation. They are useful for a different set of properties:

- establishing when an object was created and by whom;
- fixing versions and parameters so they cannot be silently rewritten later;
- allowing anyone to verify the same state;
- making assets, reputation, incentives, and contributions composable;

- preserving a long-lived public history without a single database administrator.

FlyFoundry's thesis is that neuroscience does not need to move all computation on-chain. But experimental specifications, versions, results, ownership, and incentives can benefit from a public verification layer.

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3. Why the Fruit Fly

The fruit fly occupies a rare position: complex enough to exhibit rich behavior, yet sufficiently characterized to become computationally tractable.

Drosophila can sense, navigate, learn, remember, escape, control locomotion, and display complex social behaviors. At the same time, it has one of the richest digital neuroscience ecosystems of any animal model: connectomes, cell types, genetic tools, behavioral studies, and public datasets are increasingly linked together.

MaleCNS extends this advantage by connecting the complete male brain and ventral nerve cord into a continuous graph, enabling end-to-end investigation from sensory input to motor output.[3]

FlyFoundry Genesis begins with three behavior families:

- **ESCAPE** - react to an approaching threat;
- **STEERING** - transform directional information into left/right steering;
- **COMPASS** - maintain a directional state and produce corrective output.

These behaviors represent three fundamental categories of neural computation: sensory-to-action selection, descending motor control, and internal directional state. Relevant research has identified the integration of LC4/LPLC2 signals with the Giant Fiber escape pathway,[5] the relationship between DNa01/DNa02 activity and steering,[6] and the EPG/PEN head-direction system that represents and updates heading.[7]

Phase 1 does not directly reproduce the full biophysics of these cells. The research establishes provenance, biological context, and directions for future higher-fidelity models.

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4. The FlyFoundry Thesis: From Open Data to Open Experiments

Digital science commonly stops at three layers:

1. data can be downloaded;

2. code can be open-sourced;
3. papers can be reproduced.

FlyFoundry aims to move one step further by turning a class of computational-neuroscience experiments into protocol objects:

Dataset -> Spec -> Blueprint -> Circuit -> Run -> Result -> Ownership -> Reuse

This suggests a different research model:

Conventional research object	FlyFoundry protocol object
Dataset release	Dataset commitment + manifest hash
Behavioral hypothesis	Versioned Behavior Spec
Model code	Deterministic / verifiable evaluator
Reference model	Official Blueprint
One experiment	Replayable Circuit run
Research result	On-chain verifiable state / artifact
Authorship	Creator / provenance / lineage
Reuse	Composable Circuit / Blueprint

In the long run, FlyFoundry aims to make reproducibility less dependent on social convention and more of a computational property:

> **Given the same version, the same input, and the same Circuit, any compatible client should obtain the same result.**

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5. Genesis: A Neural Foundry Anyone Can Use

Phase 1 is deliberately simple.

Users do not need to understand connectomes, neurotransmitters, or raw neuron IDs before participating. They only need to understand a manufacturing flow:

Choose Behavior -> Load Blueprint -> Run for Free -> Buy Materials -> ECLOSE -> Burn -> Own Circuit -> Mine

Experimentation is free. Materials are consumed only when a user decides to manufacture the design as an on-chain asset.

The interaction follows a familiar manufacturing intuition:

- design and test first;
- confirm that it works;
- consume production resources only when manufacturing;
- receive a permanent asset at the end.

FlyFoundry applies this model to behavior circuits.

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6. Four Neural Materials

Genesis uses four Materials. They are not one-to-one representations of individual biological neurons. They are minimal digital primitives designed to make neural behavior understandable to users and deterministic for the EVM.

Material	User meaning	Protocol role	Genesis Supply	Mint Price
SENSOR	Sense	External input port	250,000	0.00025 BNB
NEURON	Think	Stateless neural logic	500,000	0.00025 BNB
MEMORY	Remember	1-bit state element	200,000	0.00025 BNB
MOTOR	Act	Behavior output port	200,000	0.00025 BNB

Every Genesis Circuit burns exactly 20 Materials, so the standard raw-material cost is:

20 x 0.00025 BNB = 0.005 BNB + gas

A Batch's supply cap and mint price are fixed. Future capacity is introduced through new Batches rather than hidden expansion of old ones.

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7. FLY1: The First Executable Neural Logic

Genesis runs on the `FLY1` deterministic Behavior VM.

Its purpose is not to simulate an entire brain. Its purpose is to create a minimal behavior-computation layer that executes identically in a browser and in a smart contract.

7.1 Value domain

Every signal is Boolean:

- `0` - inactive
- `1` - active

7.2 NEURON modes

NEURON is a programmable two-input logic cell. Genesis supports:

- PASS
- INVERT
- ANY (OR)
- BOTH (AND)
- DIFFERENT (XOR)
- INHIBIT (A AND NOT B)

MEMORY stores one bit and updates synchronously at the end of each frame. MOTOR maps computed values to behavior outputs.

7.3 Why this matters

A Circuit can therefore be represented in only a few dozen bytes while retaining three important properties:

1. **it can run for free in the browser;**
2. **the contract can verify it again during ECLOSE;**
3. **the Circuit is small enough to be stored on-chain and replayed indefinitely.**

A modified front end cannot turn FAIL into PASS. Browser execution is the user experience; contract verification is the protocol truth.

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8. Three Genesis Behaviors

All three Behaviors consume 20 Materials and produce 20 Mining Power. The Behaviors differ in content, not in their economic multiplier.

8.1 ESCAPE

Goal: React correctly to an approaching threat.

Recipe:

- SENSOR x 5
- NEURON x 11
- MEMORY x 1
- MOTOR x 3

Public tests cover idle conditions, left/right/front threats, bilateral threats, unavailable wing/ground states, and a one-frame refractory state.

The scientific anchor comes from looming-escape research in *Drosophila*, where LC4 and LPLC2 encode different looming features and converge on Giant-Fiber-related escape pathways.[5]

8.2 STEERING

Goal: Turn in the correct direction.

Recipe:

- SENSOR x 4
- NEURON x 13
- MEMORY x 0
- MOTOR x 3

Public tests cover target direction, left/right obstacles, conflicting targets, and bilateral blocking.

The scientific anchor includes descending neurons such as DNa01 and DNa02. Experimental results show an approximately linear relationship between left-right differences in DNa02 activity and rotational velocity.[6]

8.3 COMPASS

Goal: Remember directional state and output the correct correction.

Recipe:

- SENSOR x 2
- NEURON x 14
- MEMORY x 2
- MOTOR x 2

Genesis compresses the directional system into a LEFT / CENTER / RIGHT state abstraction to demonstrate that an on-chain behavior circuit can contain memory and state.

The scientific anchor is the *Drosophila* head-direction system, including EPG compass neurons and PEN-related heading-update circuits.[7]

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9. ECLOSE: Manufacture, Burn, Own

`ECLOSE` is FlyFoundry's core manufacturing action.

When a user calls ECLOSE, the protocol atomically:

1. parses the netlist;
2. validates the Behavior and Recipe;
3. executes every canonical test;
4. requires all tests to PASS;
5. checks Material balances;
6. permanently burns the required Materials;
7. mints the Circuit ERC-721;
8. records the netlist, Spec version, and provenance;
9. registers 20 Mining Power.

If validation fails, nothing is burned and nothing is minted.

This makes a FlyFoundry asset more than an NFT pointing to an image. It is an executable asset with defined behavior semantics that can be rerun and revalidated.

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10. Scientific Provenance, Not Scientific Decoration

FlyFoundry does not use the connectome merely as branding.

Every versioned Behavior should be traceable through:

Dataset -> Literature -> Protocol Abstraction -> Behavior Spec -> Blueprint -> Circuit

Mainnet releases will pin:

- Dataset manifest hash;
- Dataset version;
- Behavior Spec hash;
- Official Blueprint hash;

- provenance URI;
- Circuit netlist hash.

Scientific understanding can evolve, but history should not be silently overwritten.

If new data, new experiments, or new simulators change our understanding of a Behavior, FlyFoundry publishes a new version instead of rewriting a sealed one:

`ESCAPE v1 -> ESCAPE v2`

Existing Circuits preserve their original semantics and history.

This is FlyFoundry's protocol expression of a basic scientific principle: knowledge is versioned, not timeless.

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11. From On-chain Manufacturing to On-chain Neuroscience

Phase 1 is only the starting point.

The broader ambition is an **Open Neural Research Network**.

In the future, a neuroscience contribution could take the form of:

- a new Dataset commitment;
- a new Behavior Spec;
- a better Blueprint;
- a new verifiable Circuit;
- a new benchmark;
- a counterexample that falsifies an older model;
- a behavior module that remains valid across environments;
- a collection of neural primitives that compose into more complex organisms.

In such a network, "research" no longer has to mean only a PDF. It can include:

Executable specification + Verifiable model + Version history + Contributor + Reproduction record + Incentive

The long-term vision is not to replace laboratories with blockchains. It is to give part of computational neuroscience an internet-native public execution layer.

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12. The Economic Layer

An open research network needs more than computation rules. It also needs scarce production resources, ownership, and sustained incentives.

The Genesis economy has a simple flow:

BNB -> Neural Materials -> Neural Circuit -> FLYF

BNB is the external value input. Materials are finite production resources. Circuits are executable productive assets. FLYF is the protocol reward and a future utility asset.

12.1 Material revenue

Genesis Material primary-mint revenue is routed as follows:

- 90% -> GenesisRevenueVault
- 5% -> Protocol Treasury
- 5% -> BuybackVault

GenesisRevenueVault prioritizes Protocol-Owned Liquidity, allowing the protocol to target:

> **Founder Initial LP = 0 BNB**

12.2 Circuit power

Genesis intentionally uses a simple rule:

1 burned Material = 1 Mining Power

Therefore:

1 valid Circuit = 20 Mining Power

There is no random rarity, random yield multiplier, or expert-only bonus in Phase 1.

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13. Genesis Points and FLYF

13.1 Before official liquidity

Before the official FLYF market is activated, there is no normal transferable-token emission.

Circuits accumulate Genesis Points according to:

Mining Power x Eligible Time

Early participants collectively share a fixed:

100,000 FLYF Genesis Reward Pool

At distribution:

- 25% is immediately claimable;
- 75% unlocks linearly over 14 days.

13.2 Official liquidity gate

The official FLYF/WBNB pool activates only when all of the following conditions are met:

- Unique Builders >= 100;
- Eclosed Circuits >= 300;
- Genesis Gross Revenue >= 2 BNB;
- POL BNB Reserve >= 1.25 BNB;
- ESCAPE / STEERING / COMPASS Specs = SEALED;
- Security Ready = true.

13.3 Phase 1 mining

After official liquidity activation, Phase 1 releases a fixed:

6,500 FLYF / day

User rewards follow:

Daily User Reward = 6,500 x User Active Power / Total Active Power

Phase 1 does not automatically change emission in response to market conditions. Future economic extensions are introduced through explicit protocol versions, not ad-hoc reactions to token price.

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14. FLYF Supply and Liquidity

Maximum supply:

1,000,000,000 FLYF

Allocation:

- 950,000,000 -> EmissionVault
- 50,000,000 -> LiquidityBootstrapVault
- Team allocation -> 0
- Future mint authority -> NONE

The 100,000 FLYF Genesis Reward Pool is reserved from EmissionVault and does not increase total supply.

Initial official liquidity target:

- Pair: FLYF / WBNB
- DEX: PancakeSwap V3
- Fee tier: 1%
- Target: 1.25 BNB + 1,250,000 FLYF
- Initial ratio: 1 BNB : 1,000,000 FLYF
- LP owner: POLVault

These values define the launch mechanism. They are not promises about FLYF market price, valuation, or investment return.

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15. Circuit Market: Executable Assets Become Tradable

Circuit is an ERC-721 on-chain asset.

Genesis Circuit Market uses fixed-price BNB settlement:

- Listing Fee = 0
- Protocol Sale Fee = 2%
- Creator Royalty = 0%

On settlement:

- 98% -> Seller
- 1% -> Protocol Treasury
- 1% -> BuybackVault

Most importantly, **Mining Power follows Circuit ownership.**

A Circuit is therefore not a static collectible. It is a digital machine with explicit execution semantics that can be replayed, traded, and used to participate in protocol rewards.

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16. Architecture: Protocol-first, Backend-light

The Phase 1 core loop can operate with only:

Frontend + RPC + Smart Contracts

The browser handles:

- Blueprint / Canvas;
- local FLY1 execution;
- animation and PASS/FAIL feedback;
- wallet UX.

Smart contracts establish final protocol truth for:

- Material supply / mint / burn;
- Behavior validation;
- ECLOSE;
- Circuit ownership;
- Mining Power;
- Genesis Points / Reward;
- Market / POL / Treasury.

Optional centralized services are limited to convenience layers such as:

- indexer;
- leaderboard cache;
- search;
- analytics;
- metadata acceleration.

These services can be rebuilt. They are not the source of truth for assets or protocol state.

A core design goal is:

> **Even if flyfoundry.com disappears, a Circuit should remain verifiable and executable as long as the chain, the public Specs, and a compatible client still exist.**

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17. Governance, Upgrades and the Seal

FlyFoundry separates an **Immutable Core** from an **Upgradeable Control Plane**.

Immutable / sealed core

- FLYF maximum supply and the absence of future mint authority;
- Material Batch supply cap / price / dataset commitment;
- Circuit ownership core;
- sealed Behavior Spec versions;
- published Dataset commitments.

Upgradeable control plane

Genesis recommends:

UUPS -> 48h Timelock -> 2/3 Safe Multisig

This applies to Eclose, the Verifier VM, Points, Reward Distributor, Market, Launch Gate, POL, and related control modules.

Additional governance parameters:

- Parameter Timelock: 24h
- Implementation Upgrade Timelock: 48h
- POL Withdrawal Timelock: 7 days
- Emergency Pause: immediate 2/3 Safe

As the protocol matures, modules can undergo **Progressive Seal**.

The principle is simple:

> **Permit repair early; reduce trust as the system matures.**

18. Roadmap: From Behavior Circuits to Digital Life

Phase 1 - Deterministic Neural Foundry

Status: test environment live.

- 4 Neural Materials;
- 3 Genesis Behaviors;
- Official Blueprints;
- FLY1 deterministic VM;
- ECLOSE / Burn / Circuit NFT;
- Genesis Points;
- Circuit Market;
- FLYF Mining after the liquidity gate.

Phase 1.5 - More Behaviors

Add more Behavior Specs and Blueprints while preserving the simple user loop:

Buy -> Run -> ECLOSE -> Mine

Phase 2 - Builder Economy

Open the real research and builder layer:

- blank Canvas;
- custom circuits;
- variable material bills;
- efficiency / fidelity scoring;
- Blueprint publishing;
- creator revenue;
- design challenges;
- more advanced PoB / simulation.

Phase 3 - Digital Fly

Combine multiple verified Circuits into a persistent Digital Fly with:

- state;

- memory;
- energy;
- age;
- experience;
- lineage.

Phase 4 - Evolution

Introduce:

- breed;
- mutation;
- fitness;
- lineage trees;
- evolutionary competition.

Phase 5 - Embodied & Open Neural Research Network

Connect Circuits and Digital Flies to:

- browser worlds;
- games;
- simulations;
- agents;
- robots;
- external research environments.

At the same time, open:

- Research Labs;
- permissioned -> permissionless Behavior proposals;
- a public benchmark registry;
- reproducibility records;
- grants / challenge rewards;
- cross-dataset neural modules.

At this stage, the core FlyFoundry object is no longer simply a "miner." It is an open neural-research primitive.

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19. A Bigger Vision: Experiments as Public Digital Objects

FlyFoundry ultimately aims to create a new kind of digital scientific object, not merely a single fruit-fly application.

Today, a scientific result is often fragmented across:

- a PDF;
- a GitHub repository;
- a data archive;
- a local environment;
- a one-off experiment with no permanent identity.

A future FlyFoundry experiment can instead be represented as:

Dataset hash + Spec version + Circuit + Inputs + Result + Creator + Timestamp + Lineage

Anyone can cite it, reproduce it, compose it, or challenge it.

If a new Blueprint is better, it does not have to remain only as a figure in another paper; it can become a new public object. If an old model fails, a counterexample can remain permanently linked to the model it challenges. If a Circuit is used in a game, robot, or other research environment, its lineage and performance can continue accumulating.

This is what we mean by:

> **On-chain neuroscience is not "putting papers on a blockchain." It is turning parts of neuroscience into an executable public network.**

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20. Scientific and Product Boundaries

FlyFoundry must clearly distinguish three layers.

Scientific Truth

- public connectomes;
- real neuron annotations;

- real experiments and literature;
- citable datasets and sources.

Protocol Abstraction

- SENSOR / NEURON / MEMORY / MOTOR;
- FLY1 VM;
- Behavior Spec;
- Blueprint;
- Mining Power.

Narrative / Future Layer

- digital life;
- evolution;
- embodiment;
- open neural research economy.

FlyFoundry does not claim that:

- FLY1 is an exact simulation of a real fruit-fly brain;
- a Circuit is equivalent to biological consciousness;
- a Digital Fly is a biological upload;
- token price or Mining returns can be guaranteed.

A more accurate definition is:

> **FlyFoundry builds verifiable digital neural systems whose provenance is grounded in real neuroscience.**

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21. Risks

Scientific abstraction risk

Moving from real neuroscience to an executable protocol necessarily involves abstraction. Incorrect mappings, excessive simplification, or overstated narratives can reduce scientific credibility. FlyFoundry addresses this by separating sources, protocol abstractions, and narrative layers, while versioning Specs explicitly.

Smart-contract risk

On-chain assets, markets, rewards, and upgradeable modules create smart-contract risk. Phase 1 uses a test environment first. Before Mainnet, the system requires testing, fuzzing, invariant checks, source verification, multisig controls, timelocks, and independent security review.

Economic risk

FLYF price is market-determined. Mining rewards vary with total network Power. The protocol does not guarantee payback or returns. Protocol-Owned Liquidity and Buyback are infrastructure and revenue-recycling mechanisms, not commitments to support a token price.

Governance risk

An upgradeable protocol creates an additional trust surface. FlyFoundry aims to reduce that surface over time through Safe multisig, timelocks, transparent upgrades, and Progressive Seal.

Regulatory risk

Digital assets, markets, rewards, and game-like mechanisms may be treated differently across jurisdictions. Genesis deliberately avoids random rarity and random yield outcomes, but future mechanisms should still be evaluated independently before deployment.

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22. Current Status

As of 20 September 2026:

- Phase 1 test environment is live;
- the Genesis product loop is implemented;
- FLY1 VM / netlist / public Behavior tests are defined;
- Genesis formulas and economic parameters are fixed as the current release baseline;
- Reward Token symbol is **FLYF**;
- Mainnet deployment addresses, final dataset/spec hashes, and security sign-off will be published separately.

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23. Closing: Start with One Behavior Circuit

The internet made information a reproducible public object.

Blockchains made assets and state verifiable public objects.

Connectomics is turning nervous systems into computational digital objects.

FlyFoundry aims to connect these three trajectories.

We begin with the simplest behavior circuit: 20 Materials, one public Behavior Spec, a netlist measured in dozens of bytes, and one replayable act of on-chain manufacturing.

But the system we ultimately want to build is larger:

> **An open network where anyone can manufacture, verify, own, reproduce, compose, and challenge digital neural systems.**

Today, it is a Circuit.

Tomorrow, it can be part of a Digital Fly.

Further ahead, it may become a new kind of open-neuroscience infrastructure.

From Connectome to On-chain Life.

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Disclaimer

This whitepaper describes the current FlyFoundry protocol design and long-term research direction. It is not an offer of securities, an investment recommendation, a guarantee of token value, or a promise of return. Future phases describe intended directions and may change based on research, engineering, security, legal, and community considerations. Scientific references support the underlying neuroscience context; FlyFoundry's protocol abstractions are independently designed digital models and should not be interpreted as exact biological simulations unless explicitly stated.