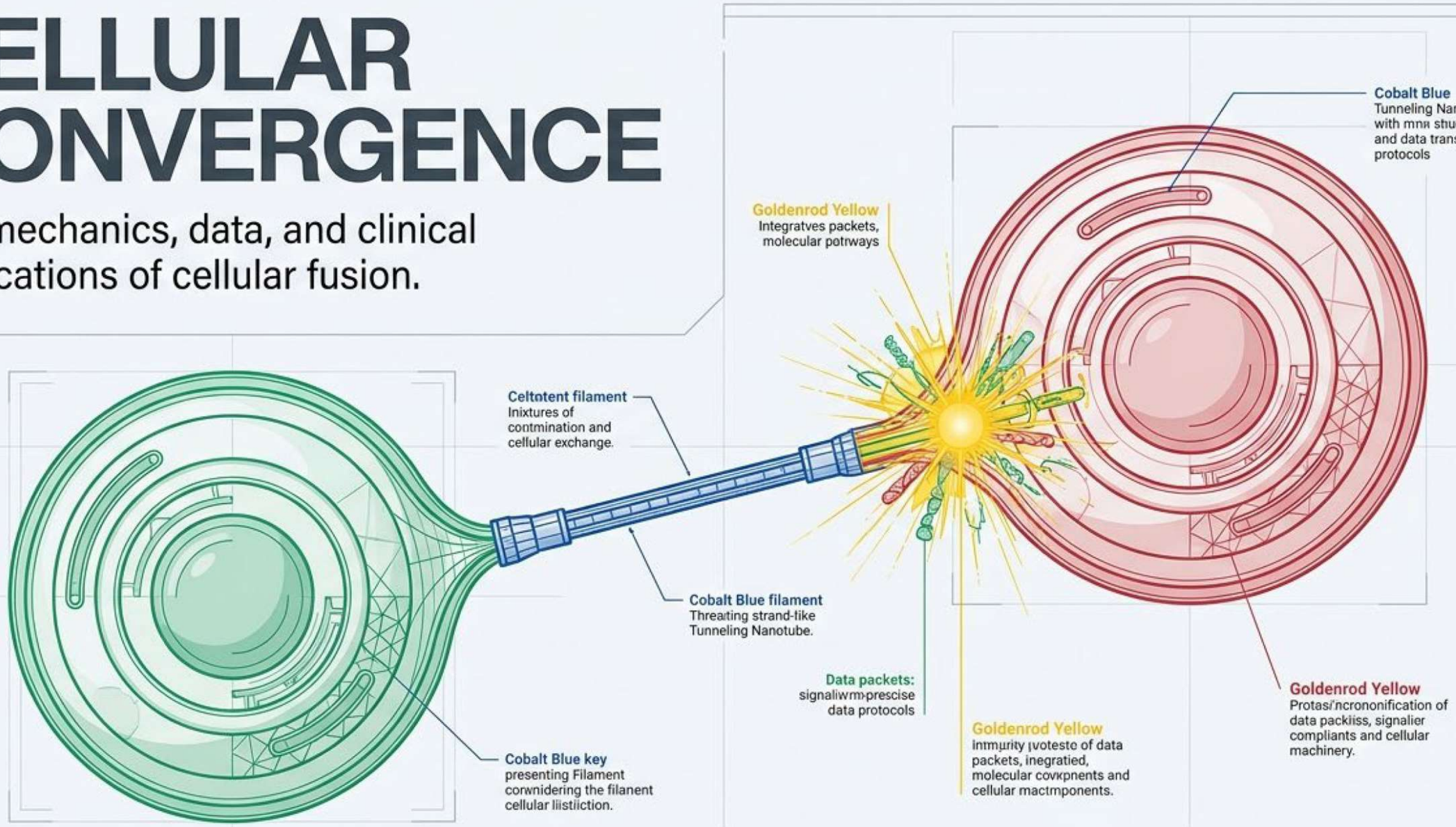
CELLULAR CONVERGENCE

The mechanics, data, and clinical implications of cellular fusion.

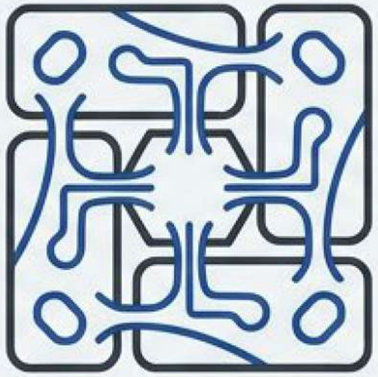


A **natural** physiological mechanism, not just a laboratory anomaly

Cell fusion and tunneling nanotubes (TNTs) occur continuously in healthy bodies under natural environmental stimuli.

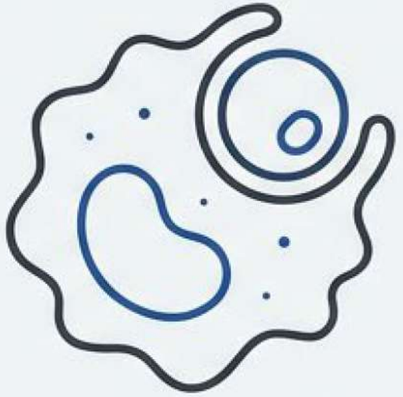
Conception

Foundational merging of sperm and ovum to initiate embryonic development.



Development

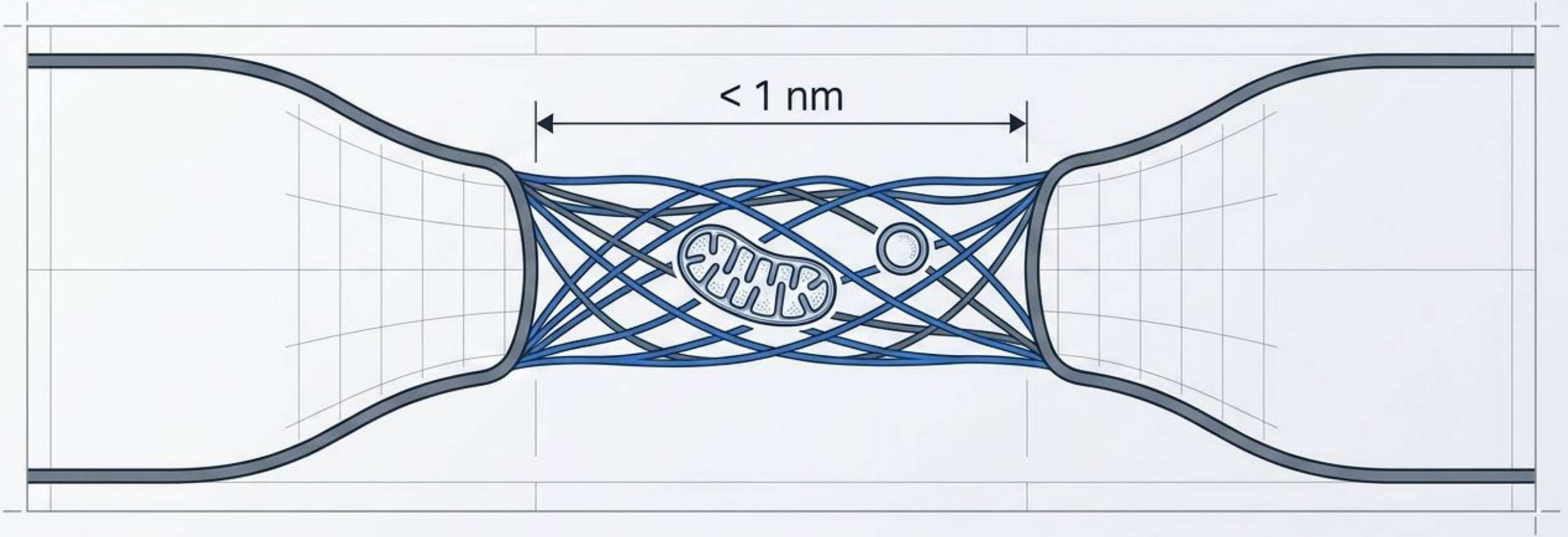
Structural tissue formation and placental integration during gestation.



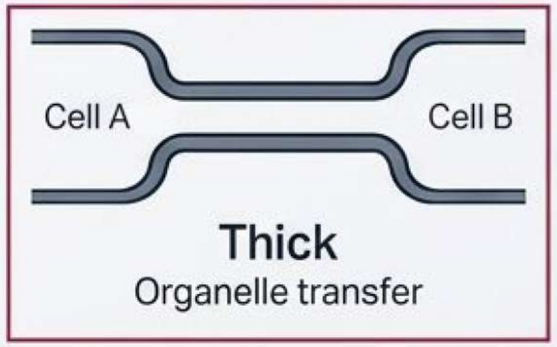
System Maintenance

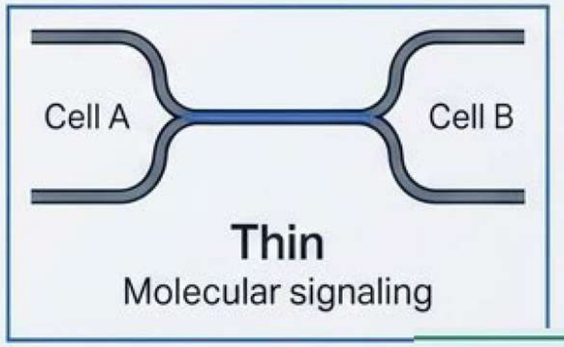
Continuous interactions among specialized somatic cells, neurons, and macrophages.

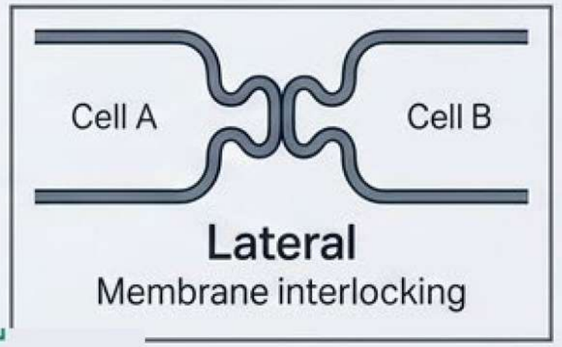
The architectural blueprint of Tunneling Nanotubes (TNTs)

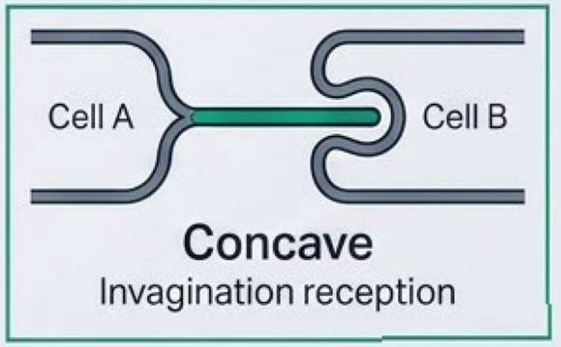


Visual Menu









Visualizing the invisible through flow cytometry

In Vitro Assay Map (2016)

Phase 1
Input

HSC/MAC - GFP Expressed

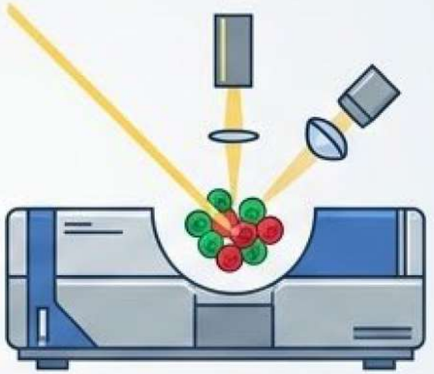
ESC - RFP Expressed

Input: 1x10³ cells

Phase 2
Process

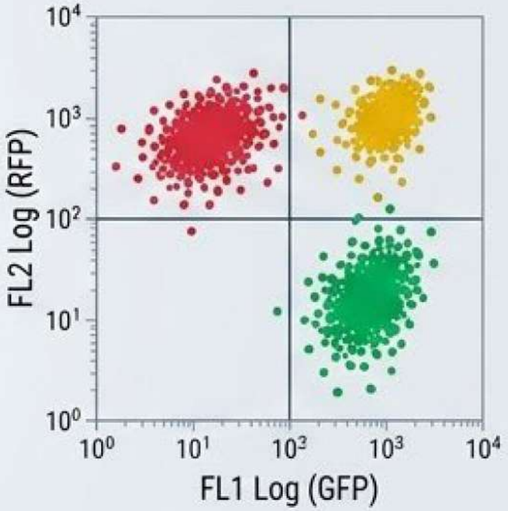
Co-cultured for 24 hours

Phase 3
Analysis



Flow Cytometry

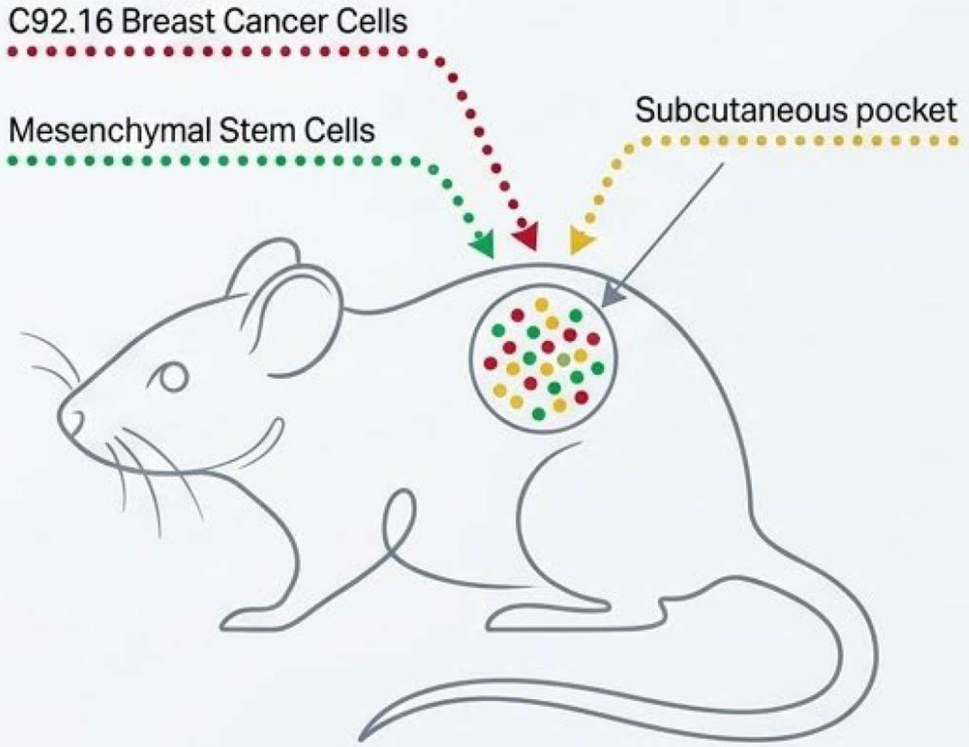
Phase 4
Output



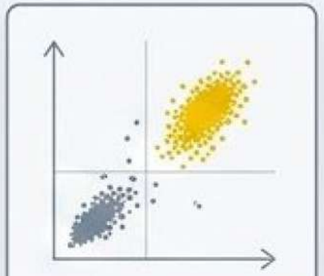
Fusion rate observed between 0.1% and 1.0%

Subcutaneous evidence confirms in vivo cellular merging

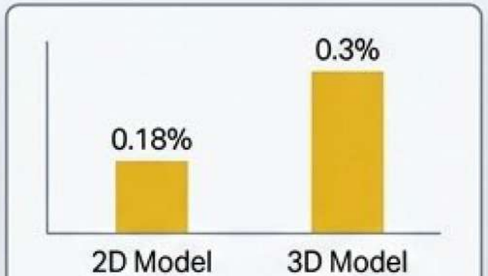
The Experiment



The Timeline Data



0.05% fusion rate



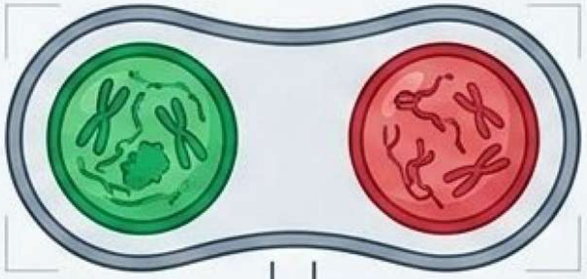
0.18% (2D Model) to 0.3% (3D Model) variance observed

Day 14

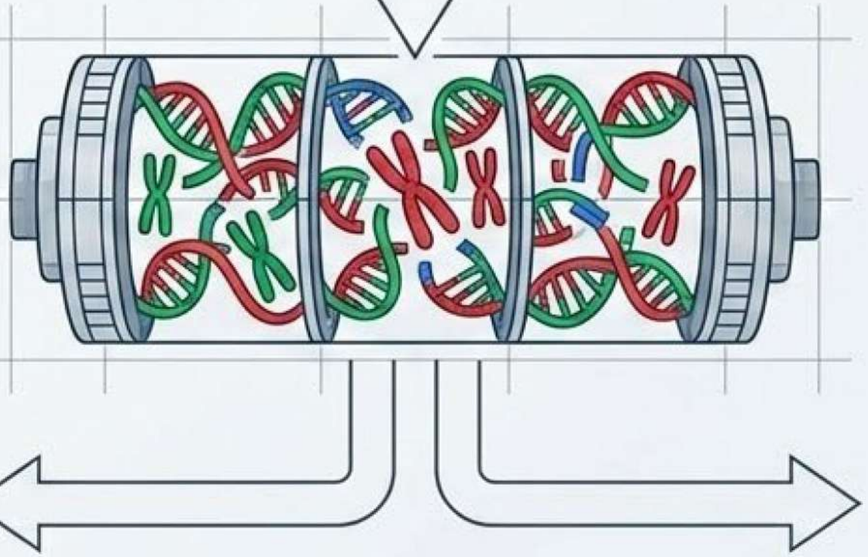
Day 51

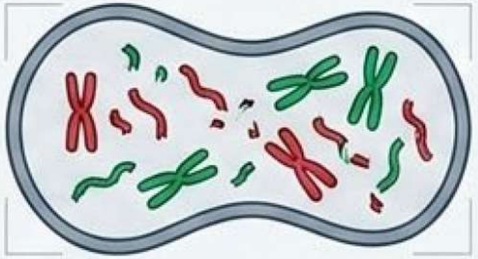
Karyogamy creates chaotic genetic combinations

1. Cytoplasmic Merger (Dual Nuclei)

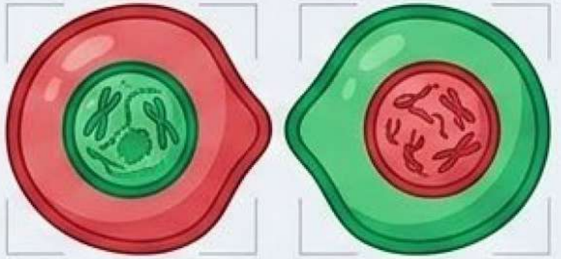


2. Envelope Dissolution & Chromosomal Shuffling





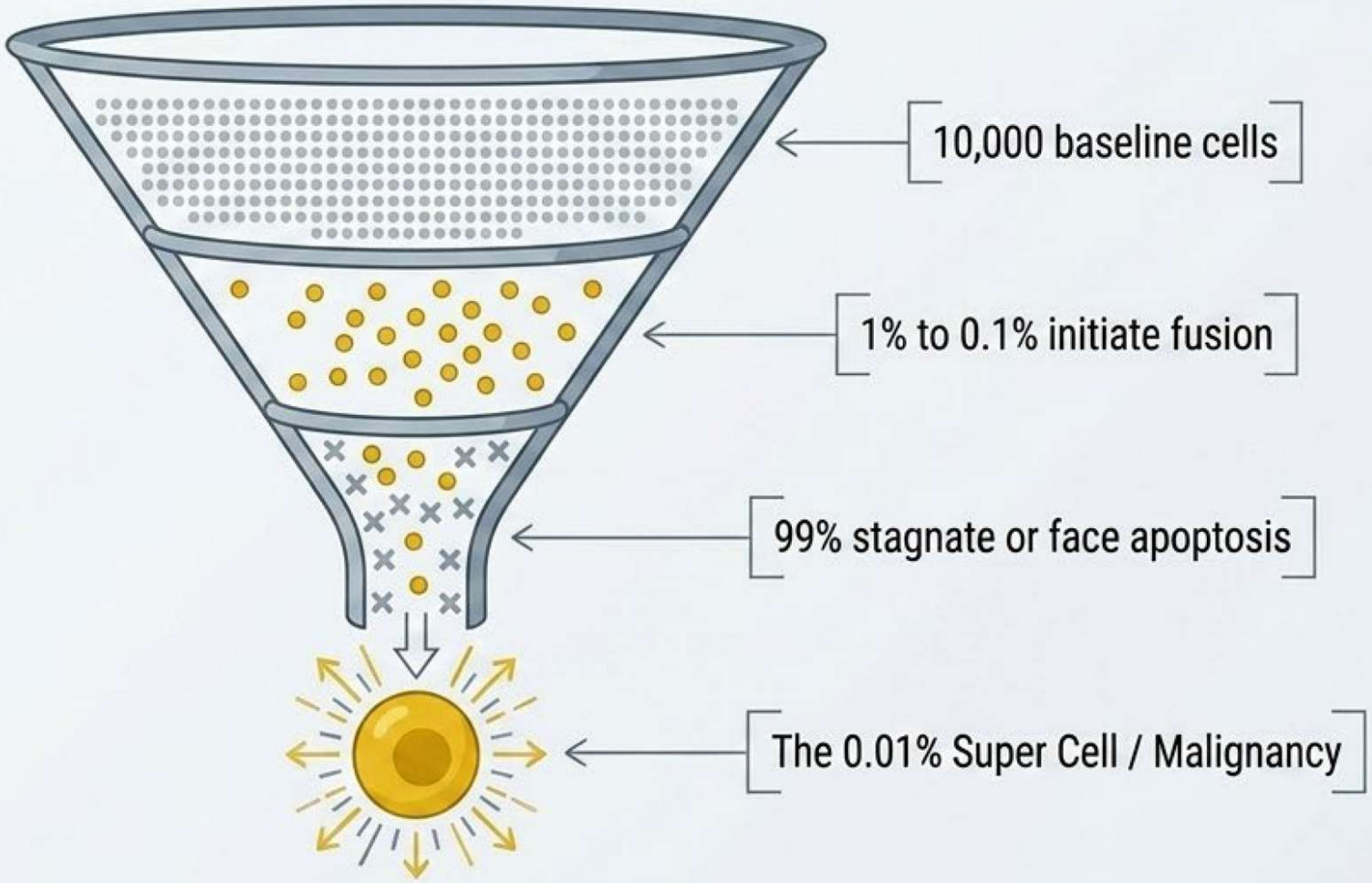
Uneven Segregation (Chromosomal Instability)



Temporary Fusion & Altered Splitting

The Cellular Survival Funnel

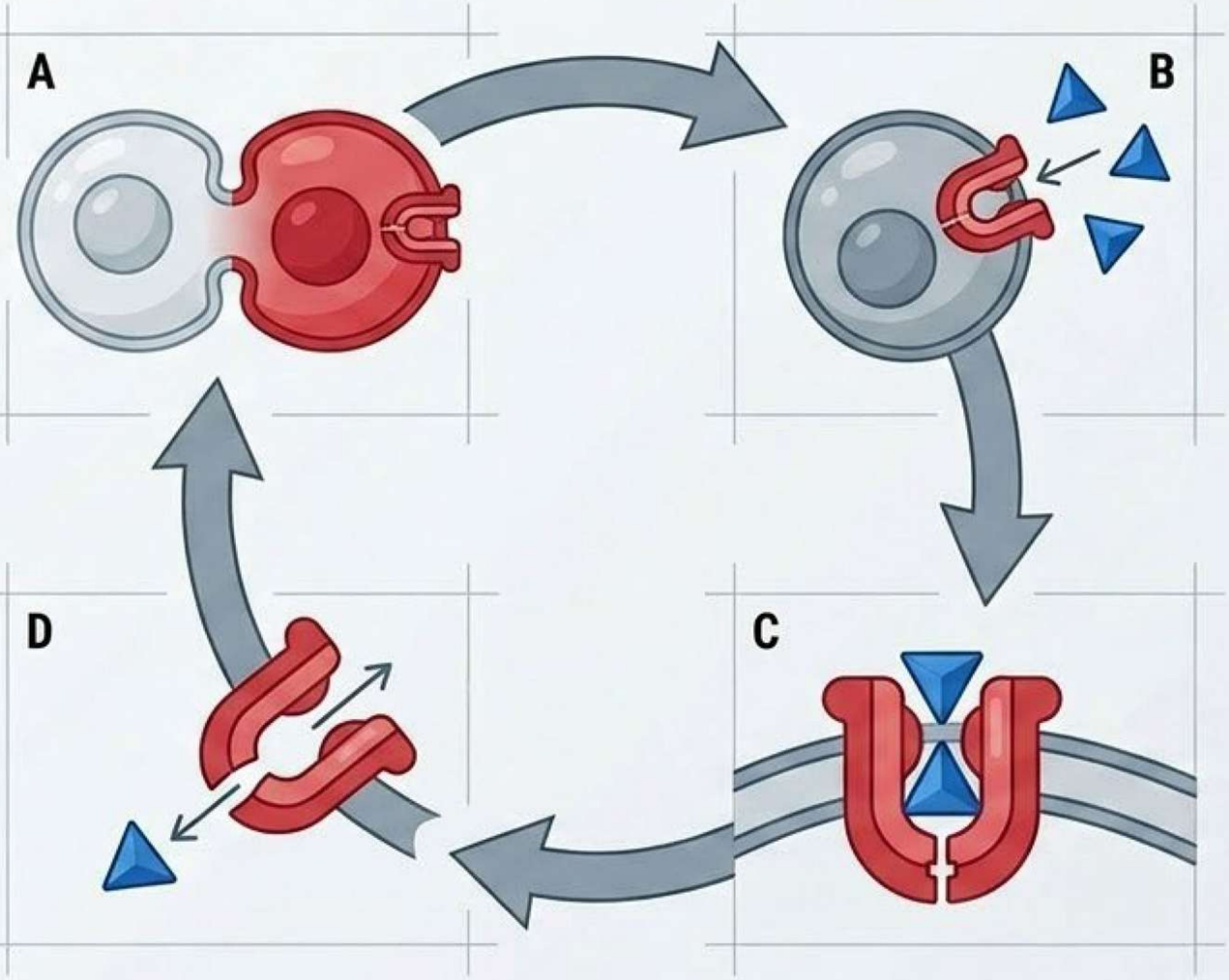
The vast majority of fused cells face uneven chromosome segregation and die. The microscopic fraction that survives adapts into highly robust, potentially malignant variants.



Acquired resistance through membrane receptor exchange

Fusion allows cells to bypass traditional mutations by directly inheriting functional resistance machinery.

1. Vulnerable cell fuses with a resistant cell, inheriting a specialized membrane pump.

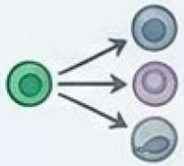
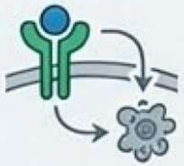


2. Clinical therapy (drug molecules) penetrates the cell wall.

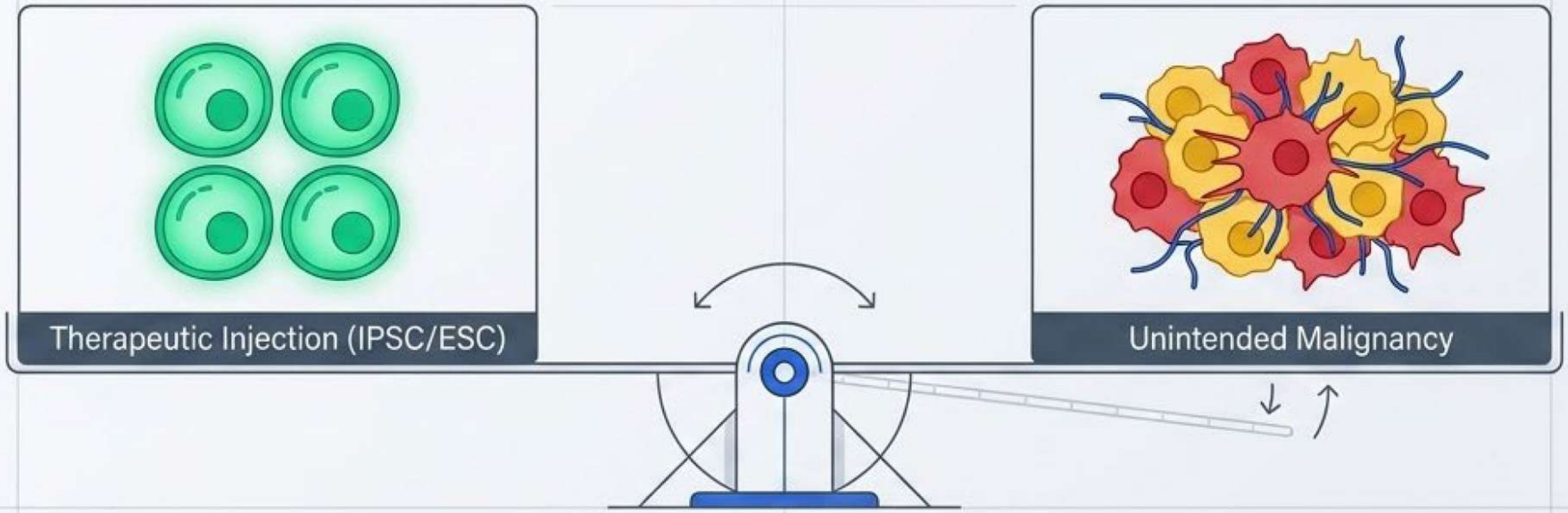
3. Acquired receptor mechanism physically captures the compound.

4. Drug is forcibly ejected into extracellular space, ensuring survival.

The divergence of cellular control

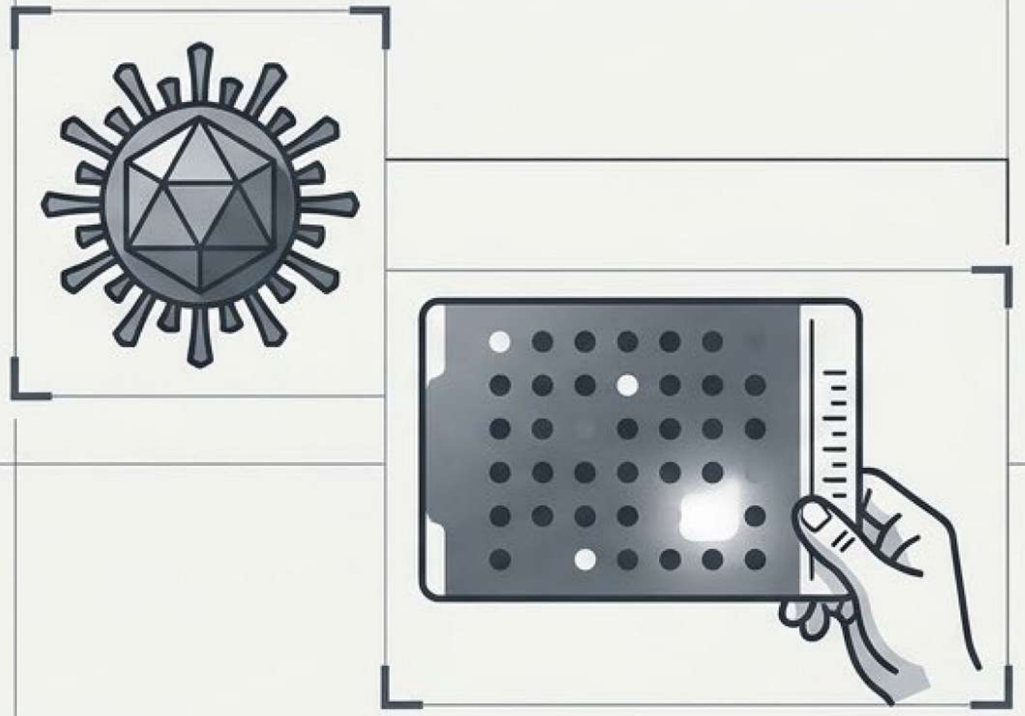
	Normal Stem Cells	Cancer Stem Cells
Origin	Standard biological tissue development. 	Malignant fusion, mutation, or unintended recombination. 
Differentiation	Strictly controlled and regulated down specific lineages. 	Highly erratic, unpredictable, and uncontrolled. 
Proliferation Capacity	Balanced system maintenance and targeted repair. 	Aggressive, unchecked duplication. 
Response to Environment	Adapts to biological signals and accepts apoptotic triggers. 	Ignores structural signals; actively evades cell death. 

The hidden risk in regenerative medicine



- Injected stem cells possess inherently high differentiation capacity and structural volatility.
- Physical proximity in localized tissue environments naturally triggers Tunneling Nanotubes (TNTs) and cellular merging.
- The collision of high-capacity therapeutic cells with host tissue creates an unpredictable environment for unregulated genetic recombination.

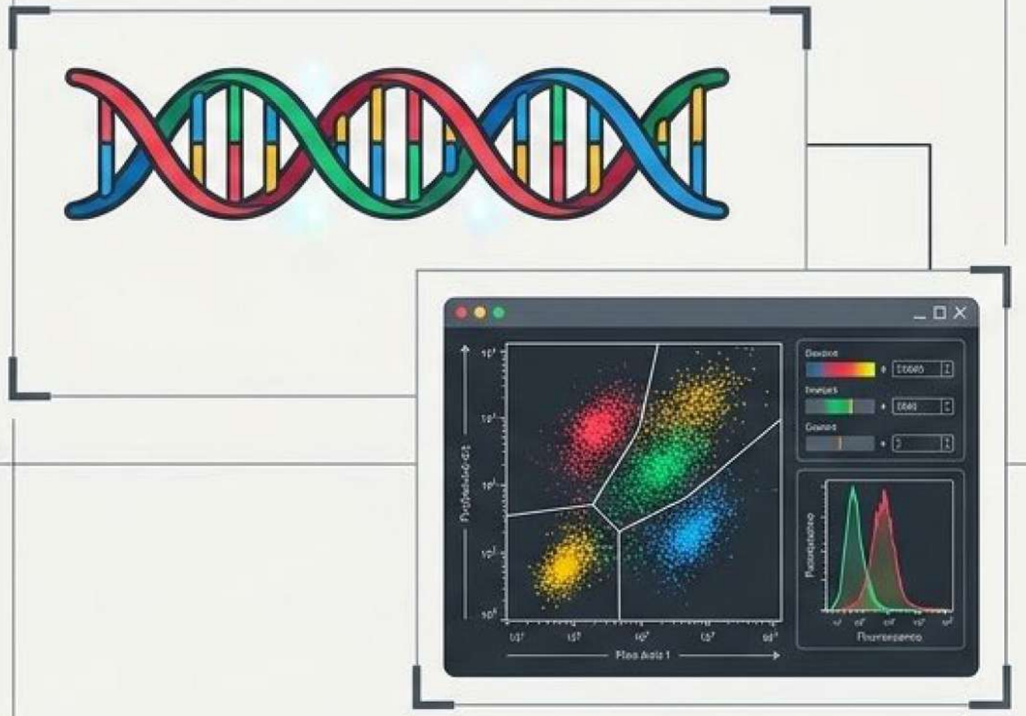
Five decades of fusion observation



1971

Induced fusion via Sendai virus.

Tracked manually by physically counting radioactive exposure dots on X-ray film plates in analog darkrooms.



Present Day

Natural fusion mapping.

Tracked continuously via Long-read NGS (Next Gen Sequencing) and automated high-throughput fluorescent monitoring.

Taxonomies of cellular exchange

Tunneling Nanotubes (TNTs)	Direct Cell Fusion	Phagocytosis / Bacterial Transfer
< 1nm physical gap	0nm (Membrane merge)	Complete physical engulfment / Pili connection
Vesicles, Cytoskeleton, Mitochondria	Cytoplasm, Entire Nuclei, Chromosomes	Extracellular material / Foreign Plasmids
Temporary biological scaffolding	Permanent merging or altered chromosomal division	Immune system clearance / Antibiotic resistance acquisition

The dual-edged sword of cellular evolution

The exact mechanism required to generate life is the exact mechanism that enables malignancies to survive it.