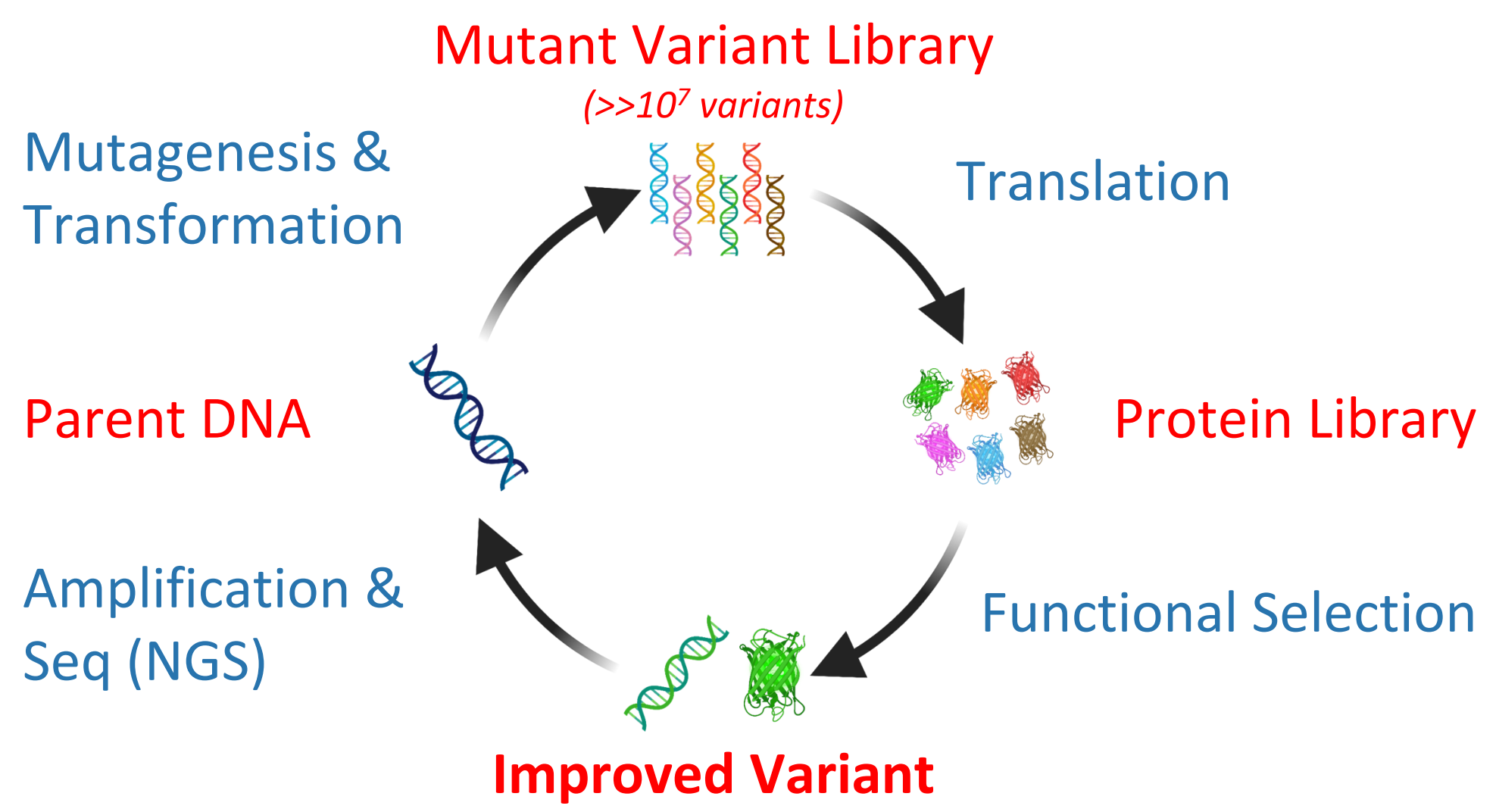
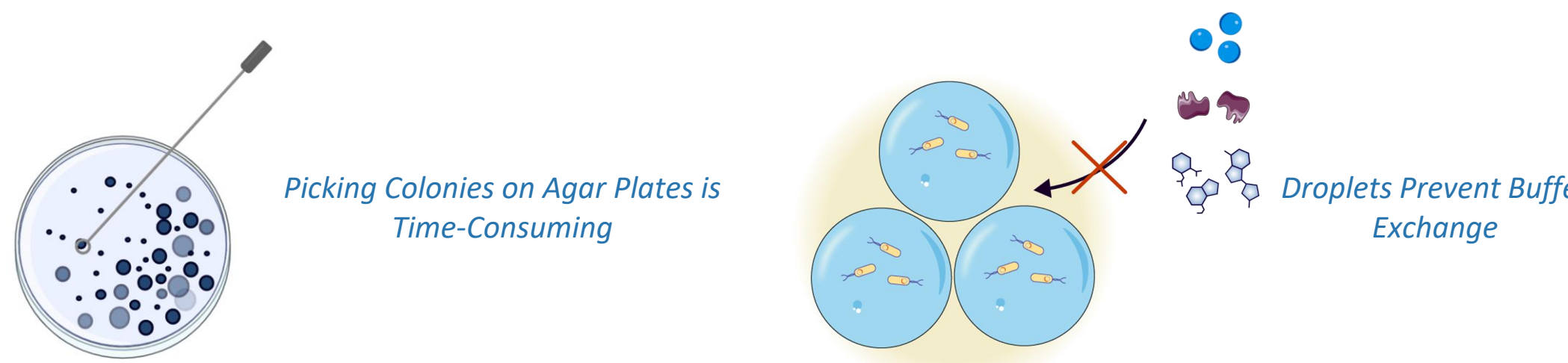
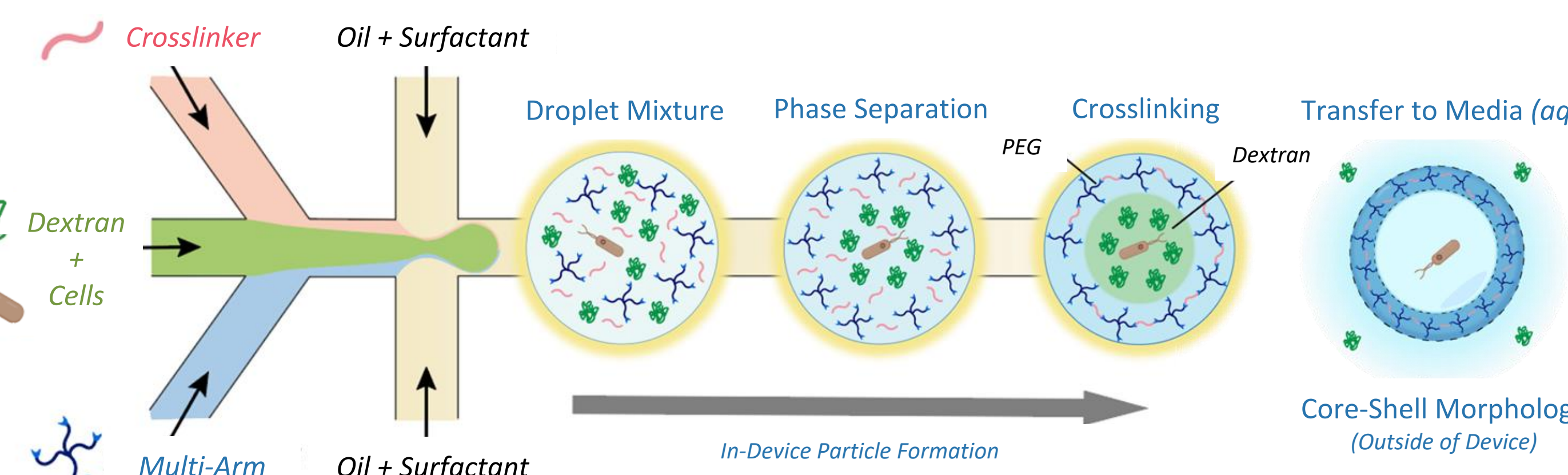
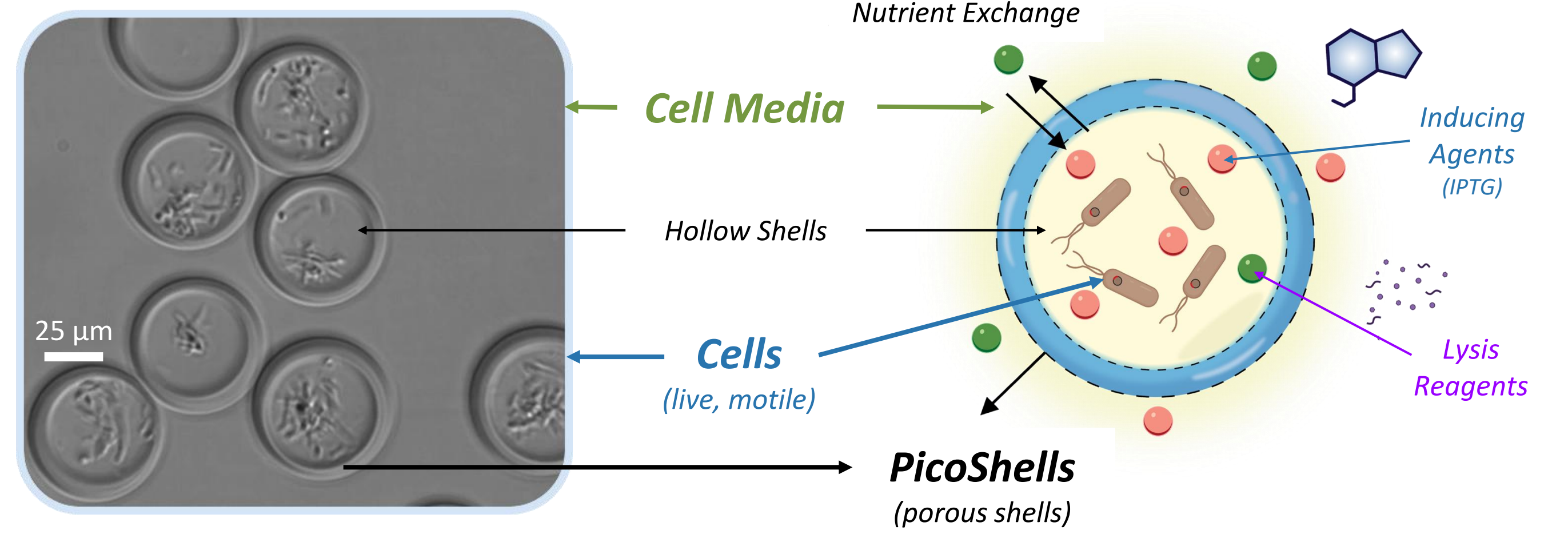


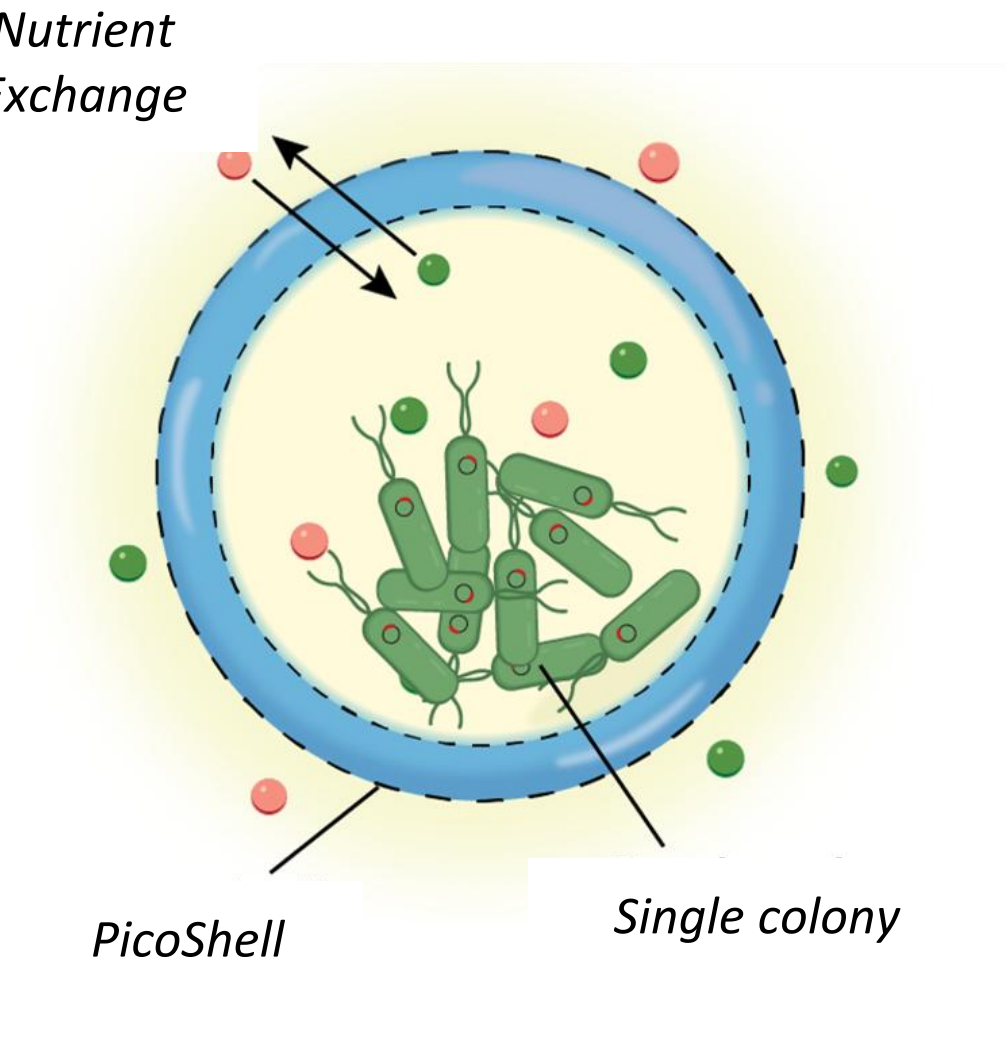
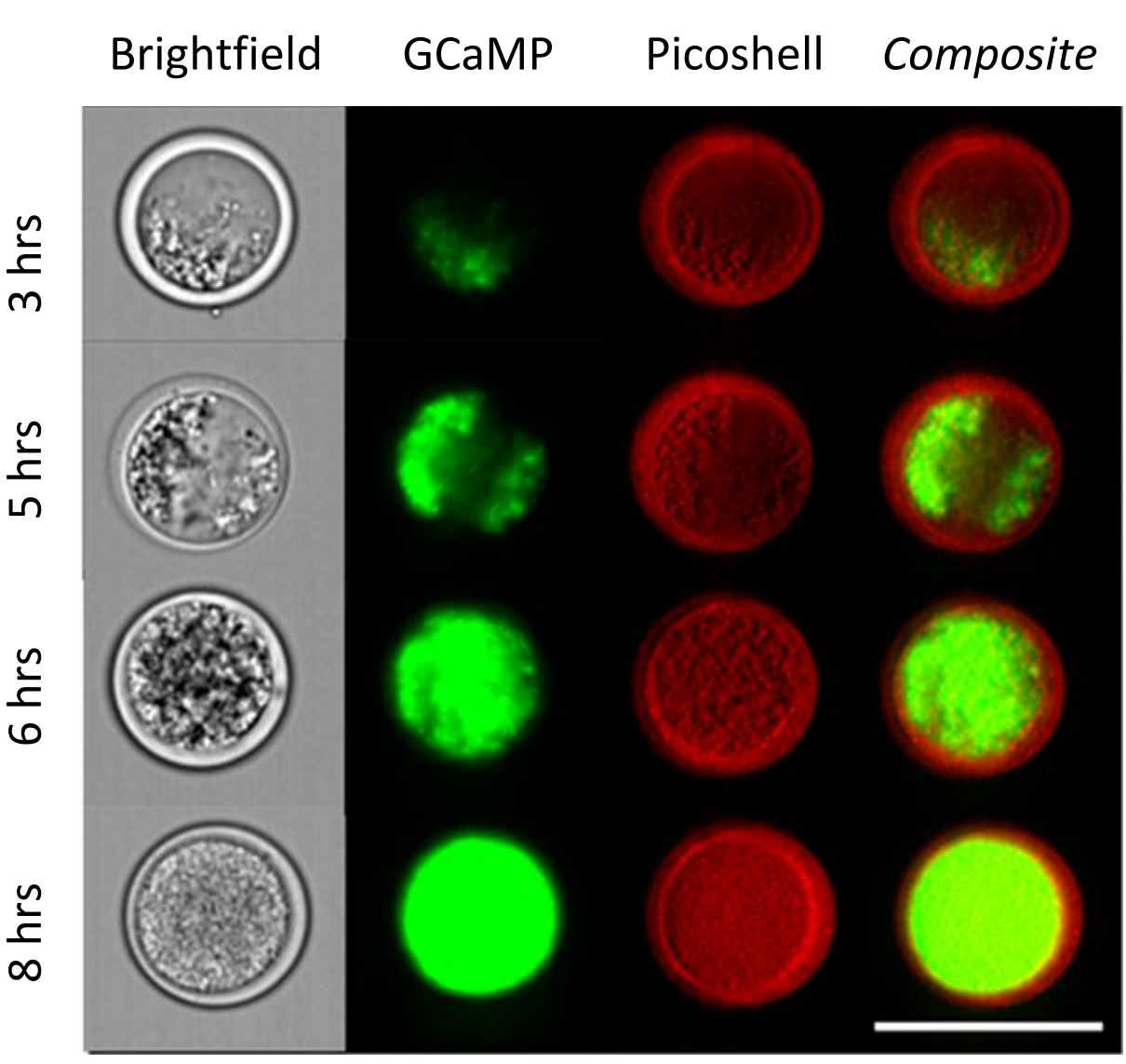
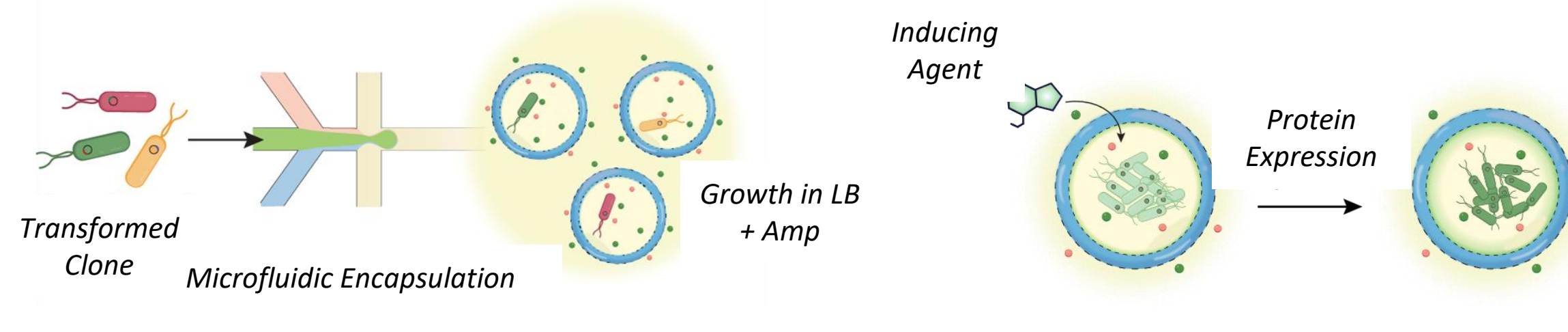
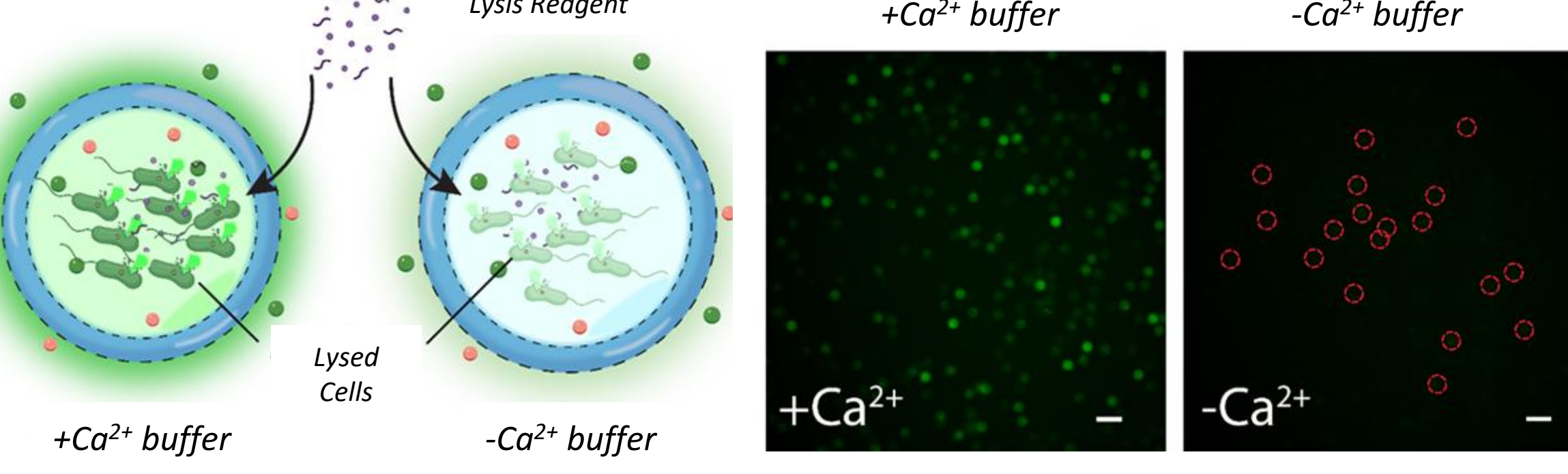
Background

- **Deep Mutational Scanning** of protein variants by:
 - **Directed Protein Evolution**: screening novel proteins
- 
- Current Colony Screening is limited (*Weeks to Months*)
 - **Low Throughput** ($\sim 10^3$ - 10^4 variants)
 - **Limited** Complexity of Function & Phenotypic Variability
 - **High-Throughput Accelerated Workflow** (*Days to Weeks*) screening millions of variants for dynamic function
- 

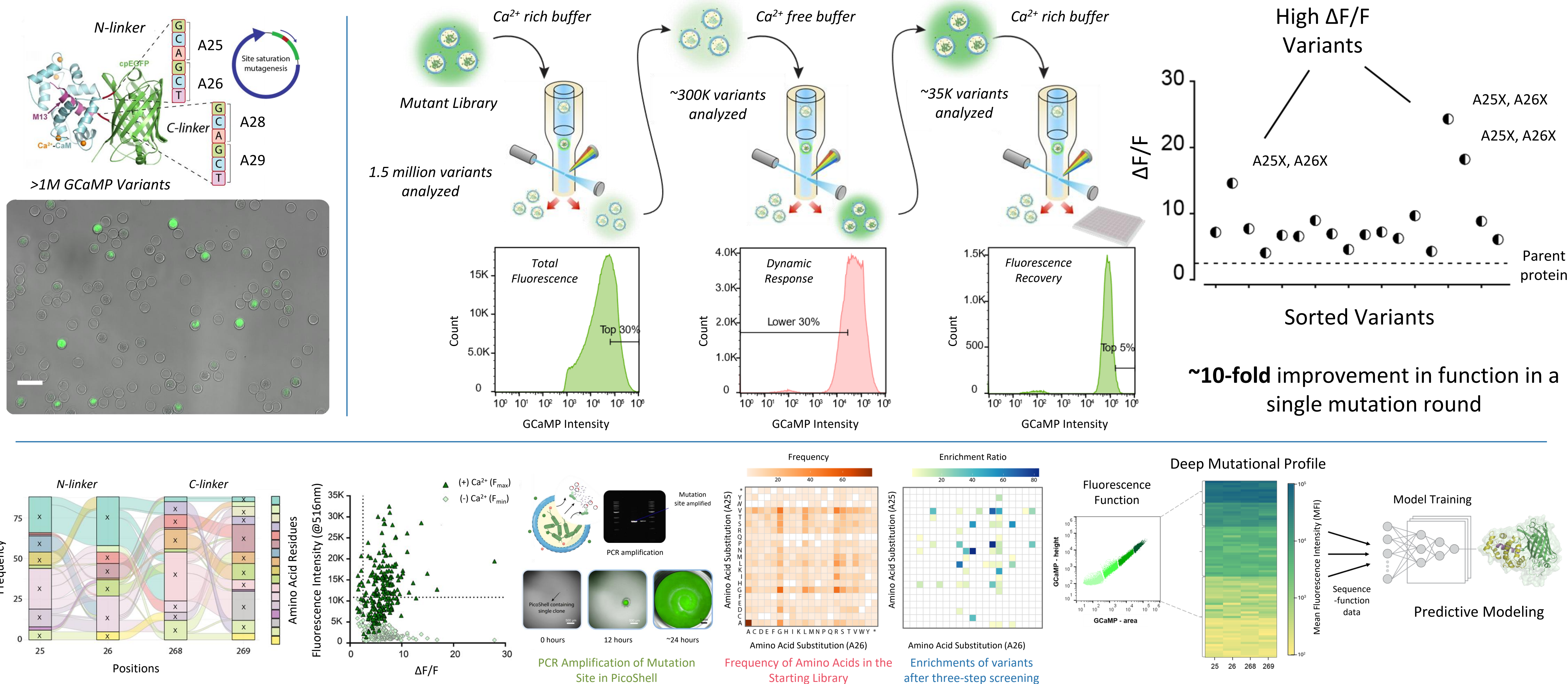
PicoShells: Lab on a Particle

- PicoShells are **hollow hydrogel microparticles** enabling single-cell or colony encapsulation, allowing for analysis of **millions of clones** within a single day!
- Fabrication of PicoShells using **Microfluidics**:
 
- Enables Buffer/Solute Exchange & **Growth in Media**: Multi-Step Workflows
 


PicoShell Demonstration

- PicoShell **Clonal Population Growth** (*E. coli* expressing *GCaMP*)
 

- On-Demand Inducible Protein Expression
 


High-Throughput Functional-Based Screening Workflow



Conclusions and Future Directions

- PicoShells enable **single-cell or colony screening workflows** that can be leveraged for **functional assays**.
 - PicoShells, combined with **FACS**, screened **millions of clones** in a **single-day's workflow**, significantly improving the directed protein evolution.
 - This demonstrates the platform's efficiency at **screening a mutagenized library** and **sorting/selecting bacteria** producing fluorescent **GCaMP**.
 - **Antibiotic Susceptibility Testing (AST)** on **bacteria spiked in whole blood** and isolated to encapsulate into PicoShells and screen for various **MICs**.
 - **PicoShells and Nanovials** can be leveraged to study **cell-cell interactions** or isolate RNA (**scRNA-seq or bulk seq**) and **single-cell assays**.
 - We are also **optimizing** PicoShell porosity and quality of the hydrogels to improve the robustness in downstream workflows.
- 

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