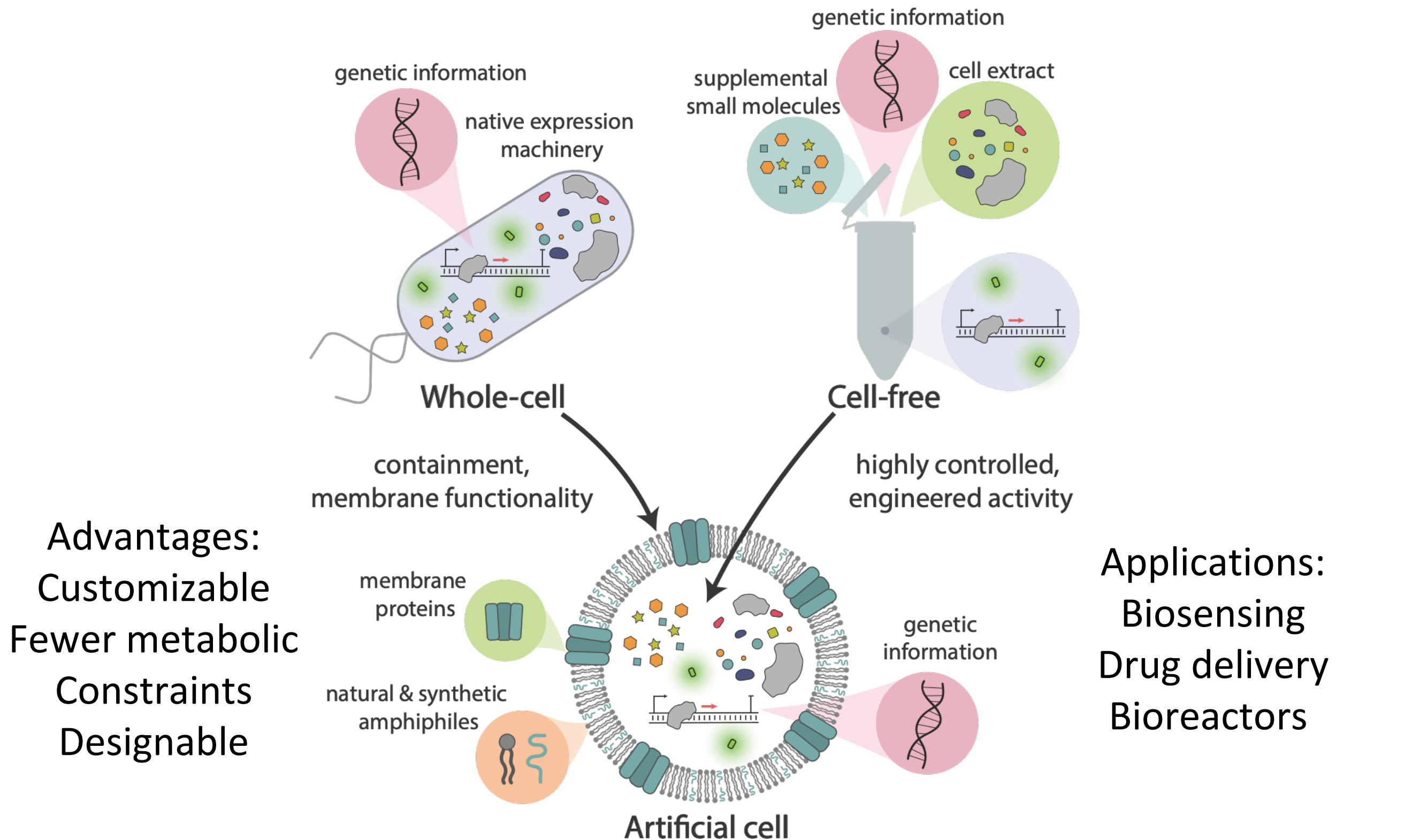
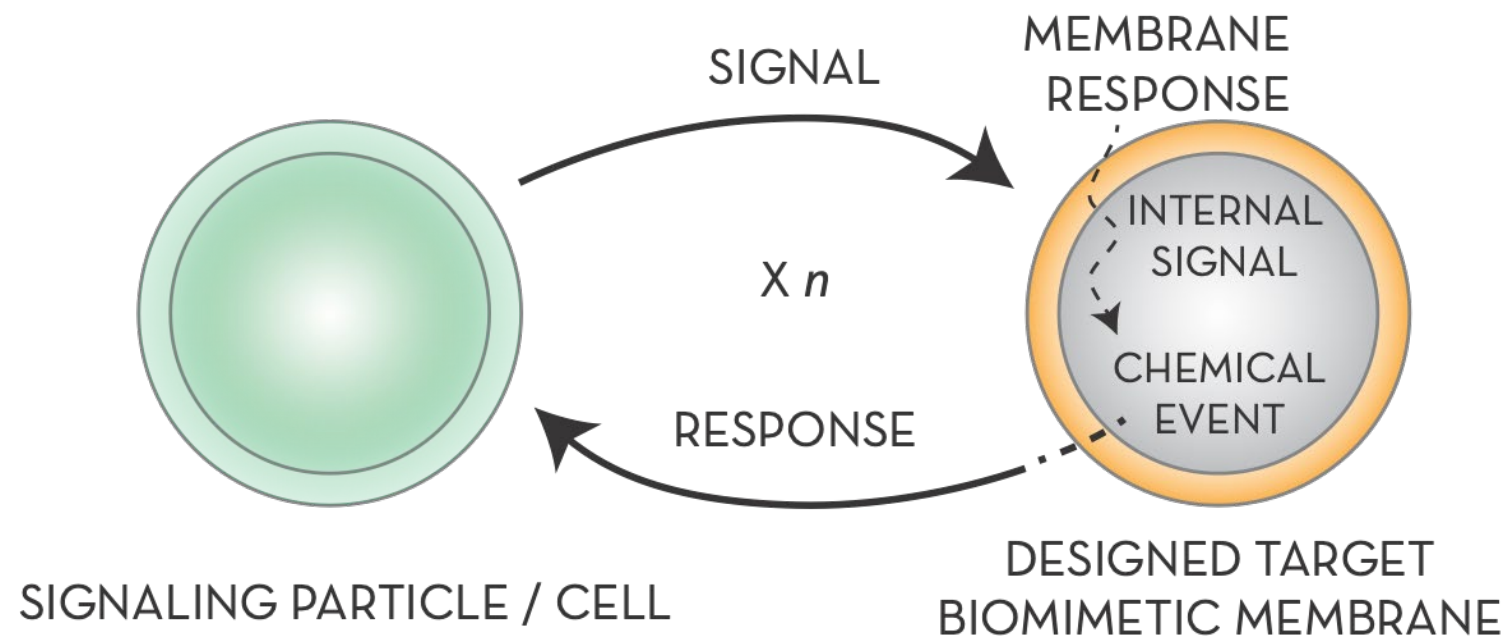


THE PROMISE OF SYNTHETIC CELLS



Future applications of synthetic cells



BIOSENSING

MATERIAL INTEGRATION

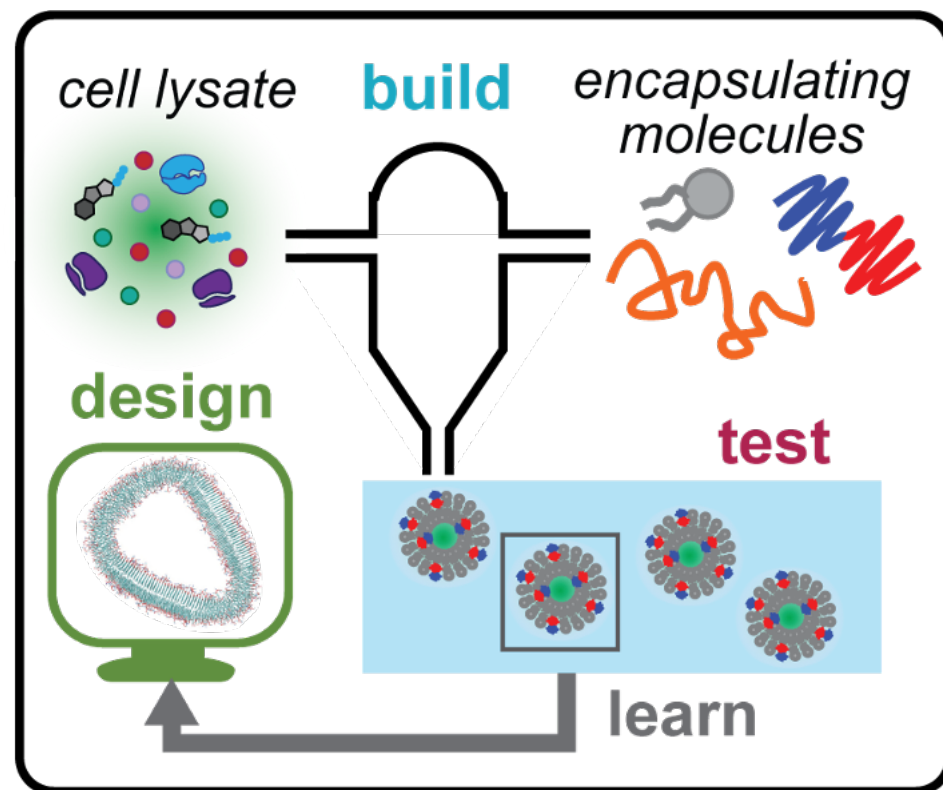
NEW DRUG DELIVERY
VEHICLES

CURRENT LIMITATIONS:

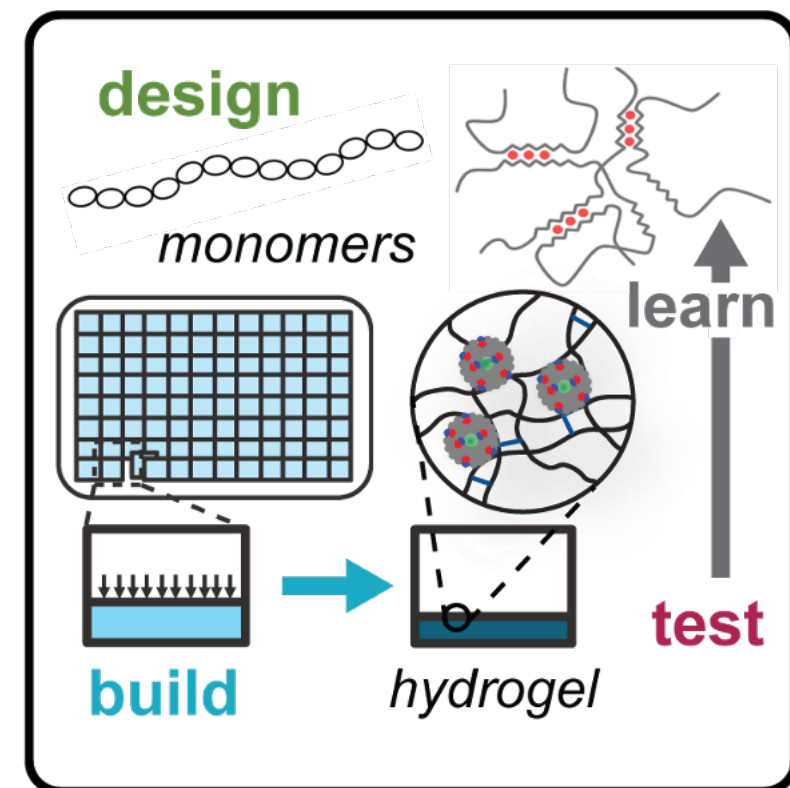
- Limited lifetime of activity (difficult to reload with nutrients).
- The timescale of RNA synthesis (min) and protein synthesis is long (hrs). How can we speed up the responses of cell-free expression based artificial cells?
- We don't understand the design rules: what compositions yield the best activity in a given environment or how population level behaviors change when artificial cells are mixed.

Primary advantage of synthetic cells: the ability to design and program artificial cell behaviors

How do membrane and cell-free components impact artificial cell function?

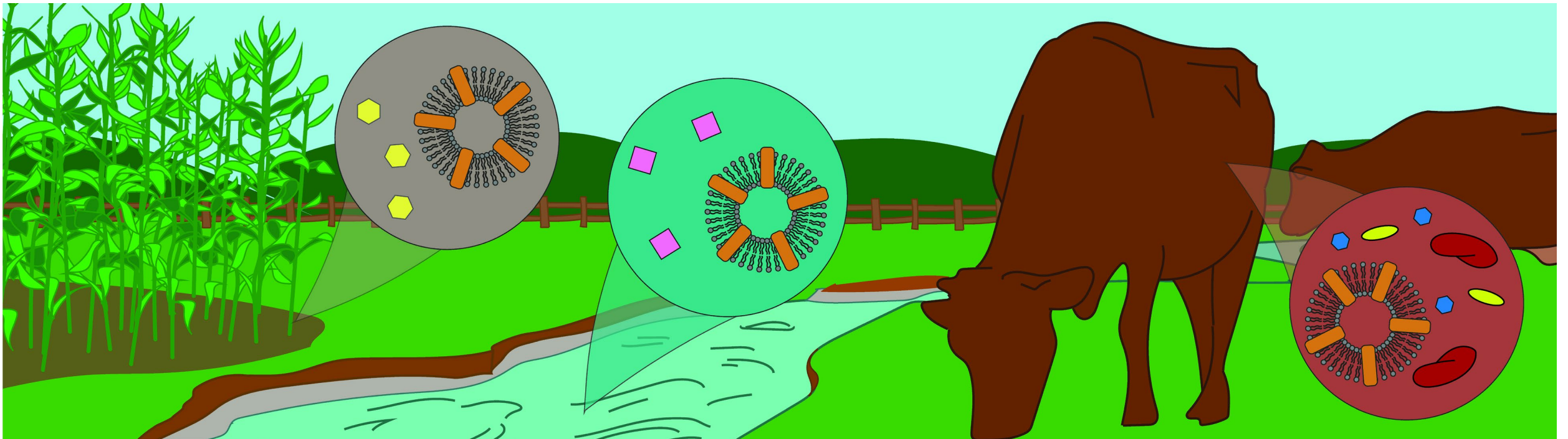


What are the optimal components when we co-design artificial cells with other materials?

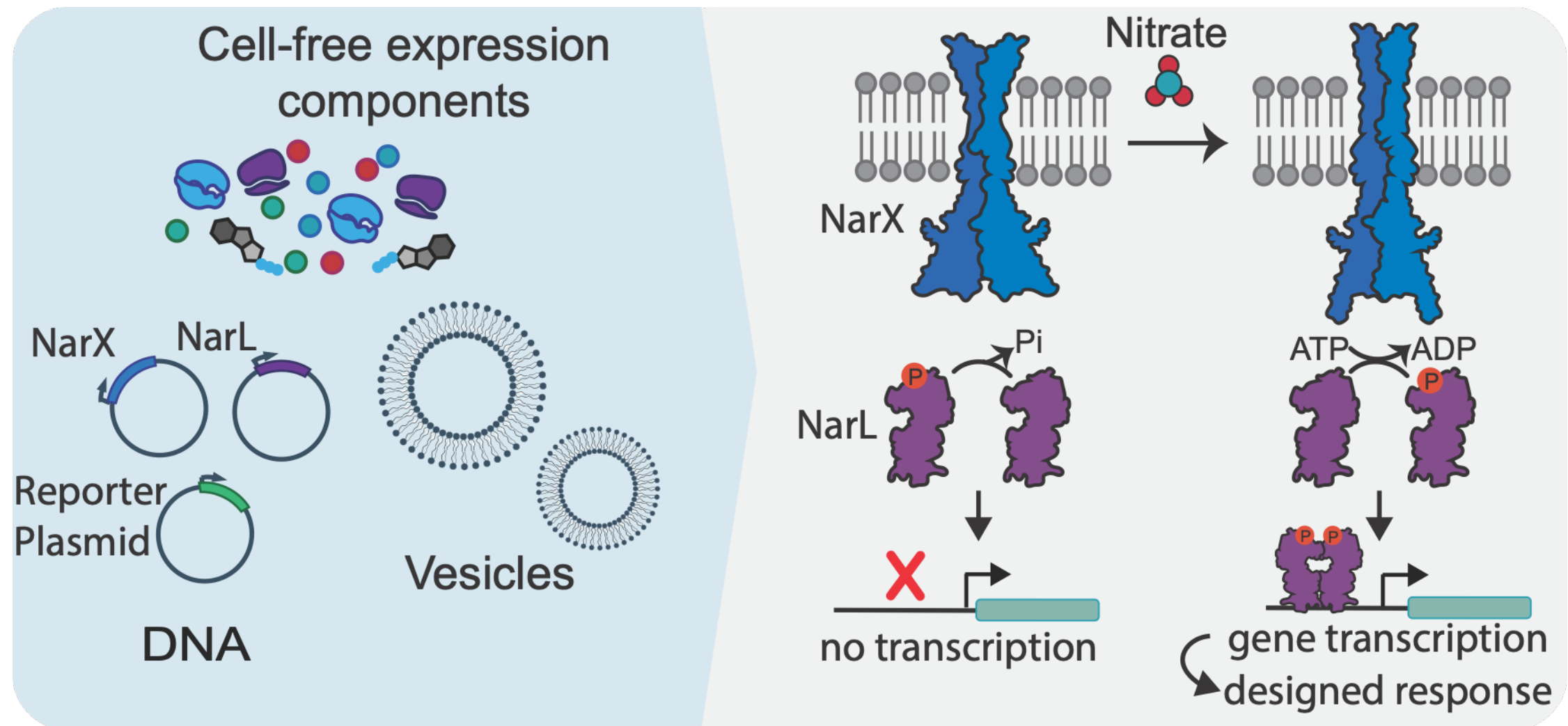


A biosensing example:

Long-term goal: Can we detect signals *within* an environment of interest?



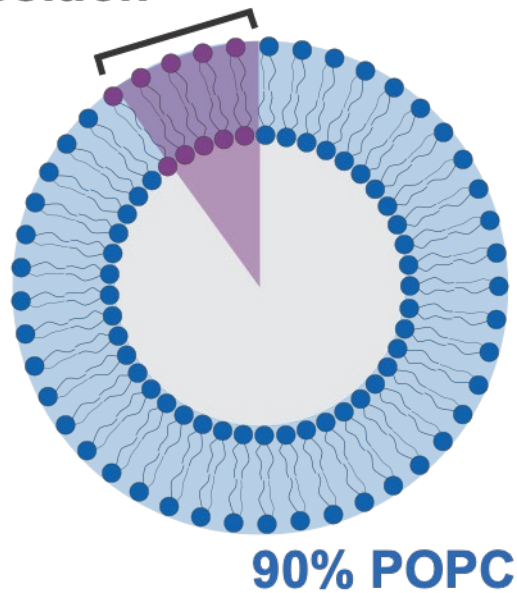
Starting point: How can we detect information without moving molecules?



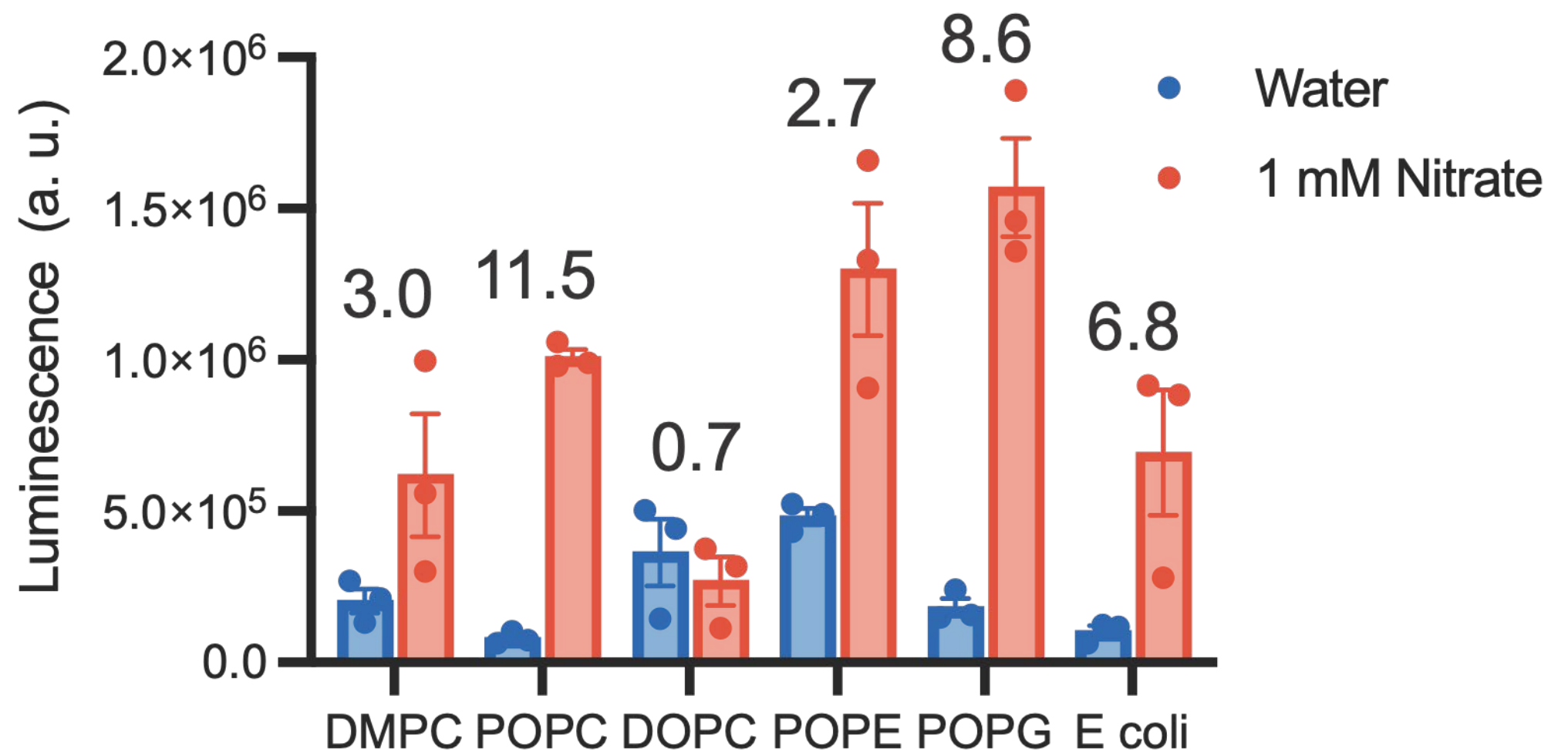
Signal transduction with two component systems

10% Altered Lipid Composition

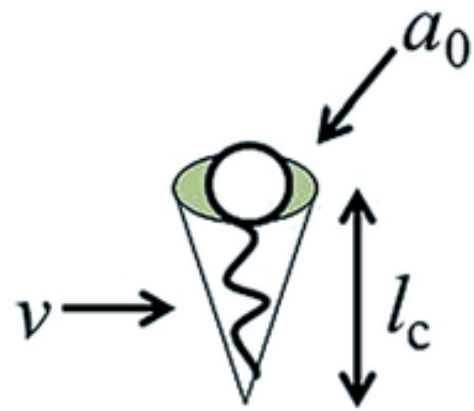
DMPC
POPC
DOPC
POPE
POPG
E. coli



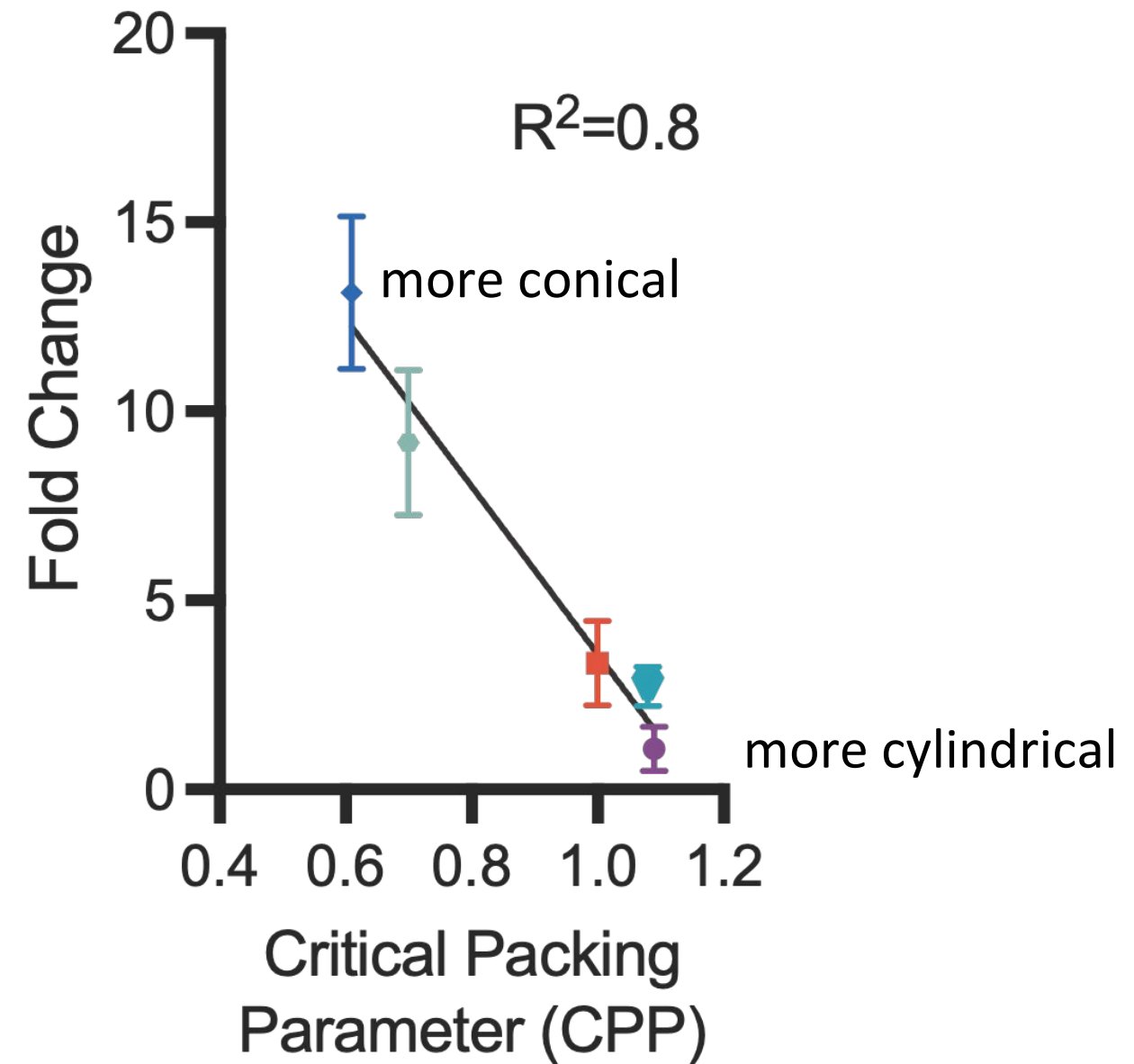
Lipid membrane composition affects the performance of the cell-free TCS sensor



Critical packing parameter is an important driver of TCS performance



$$\text{CPP} = v/a_0 l_c$$



Synthetic cell research is more readily adopting
AI techniques to uncover new relationships
between composition and function but...

We need theory and understanding

Could AI slow science?

Confronting the production-progress paradox



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