



LUMEN
BIOSCIENCE

Company overview

Incorporated 2017 and acquired core IP

- \$11.2M venture capital financing
- Grant funding: Gates Foundation, US Dept. of Energy, NIH, USDA
- Active academic collaborations: UW, Tufts, NREL, Wadsworth Center, OSU, ASU

2018 established wholly owned subsidiary to hold colors business

- Preserve flexibility for future capital transactions and transaction tax planning

cGMP/FSSC 22000 pre-audit complete; final certification audit pending



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Two key technology advantages:

1. Fully cGMP controlled, US-based indoor production and processing
2. Biotechnology advantage with zero non-native DNA

The background of the slide features a complex, abstract pattern of light blue circles and lines of varying sizes, creating a molecular or network-like structure. The circles are connected by thin lines, and some circles are larger than others, giving it a sense of depth and complexity. The overall color palette is a soft, pale blue.

Indoor Production

Standing on the shoulders of giants

Production and extraction technology pedigree:

1. Recent decade of intense biofuels industry research into microalgae cultivation and extraction technologies
2. Huge recent advances in LED technology and related supply chain expertise
3. Indoor cultivation/aquaculture biology knowhow
4. Washington hydro

Production/extraction technology benefits

Indoor production

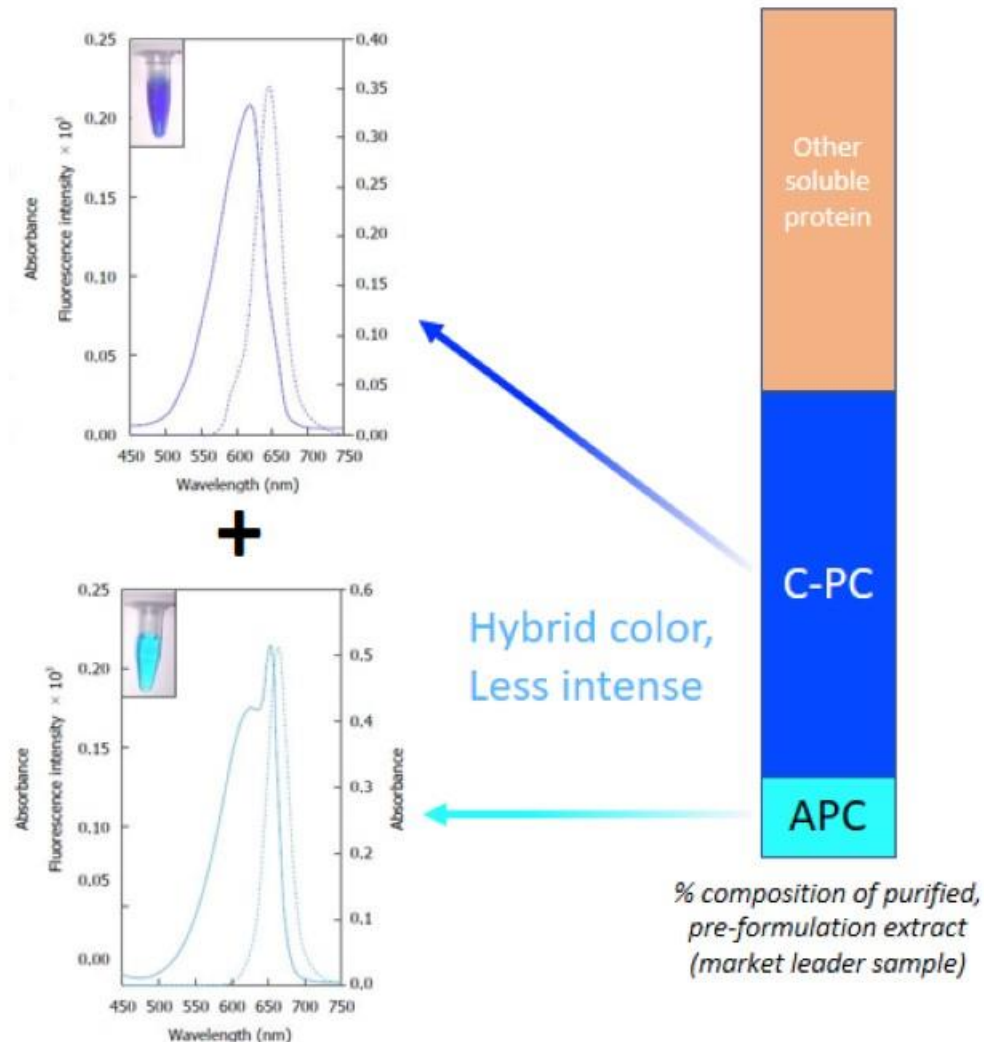
- Total seasonality and product consistency control
- No risk of toxic blooms, pesticide over-spray, bird or insect contamination
- No outdoor ponds avoids evaporative water loss and associated environmental issues
- No need for large scale agricultural water negotiations to for future expansion
- Top-to-bottom cGMP controls enable continuous yield improvement and lean manufacturing

All US production

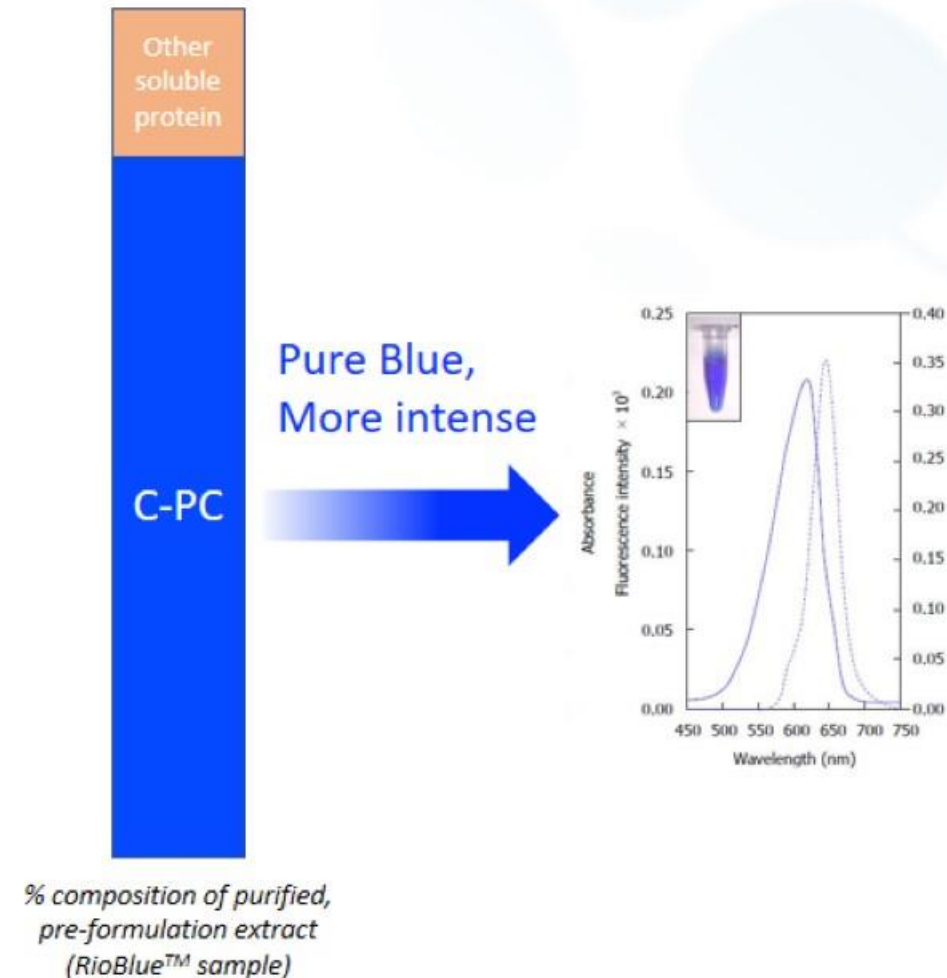
- Complete confidence — no adulteration
- Easy food safety audits under FSMA with domestic supplier
- No risk of exchange rate, tariff or geopolitical supply chain disruption

Making a truer blue

Market standard: a blend of blue and cyan



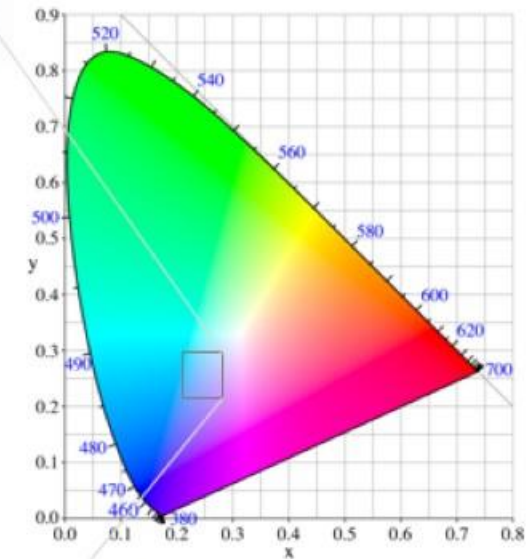
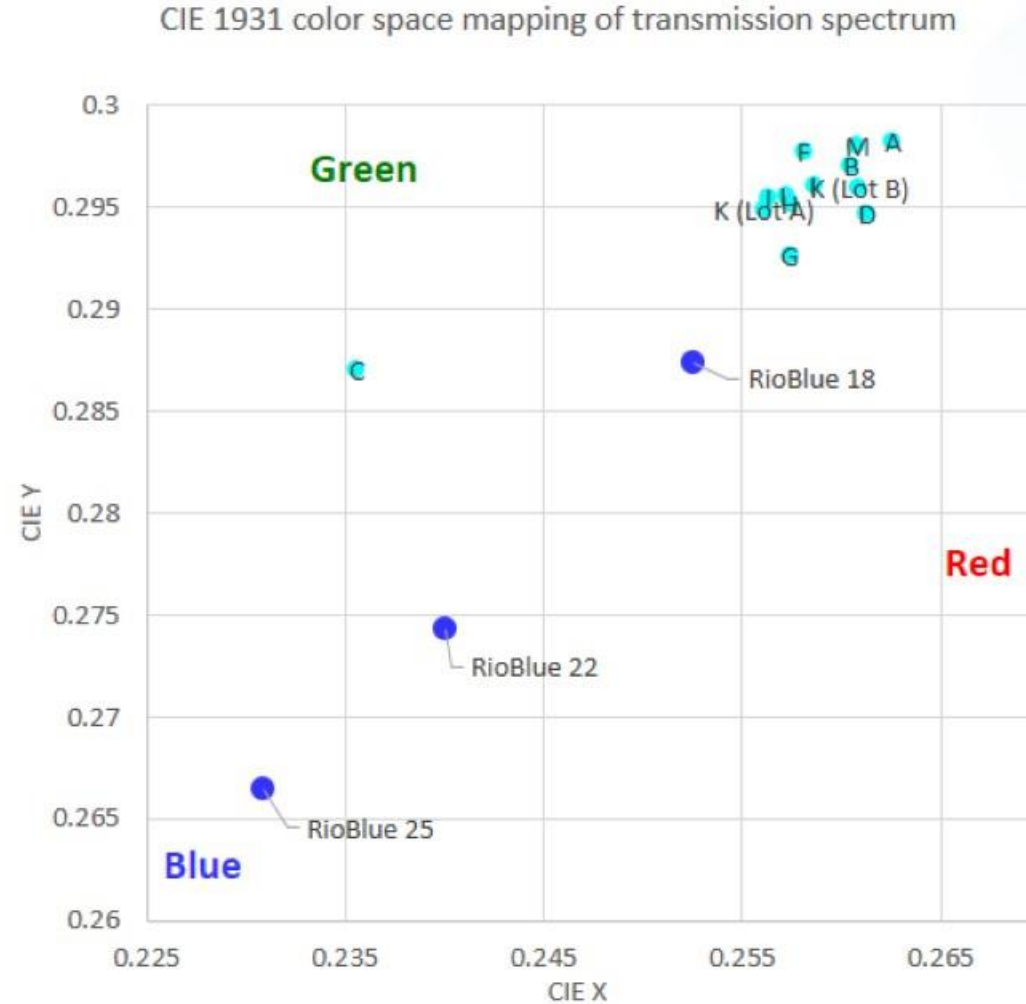
RioBlue is true blue



Color space mapping of RioBlue™ compared to competitor products

Visible light transmission spectra of RioBlue™ and competitor products converted to CIE 1931 XYZ color space

- Most standard phycocyanin products cluster in the teal-blue region
- One competitor product ("C") shows an unusual composition and anomalously high color value for the cPC concentration
- RioBlue™ has a higher cPC/aPC ratio compared with competitors and demonstrates a stronger blue color

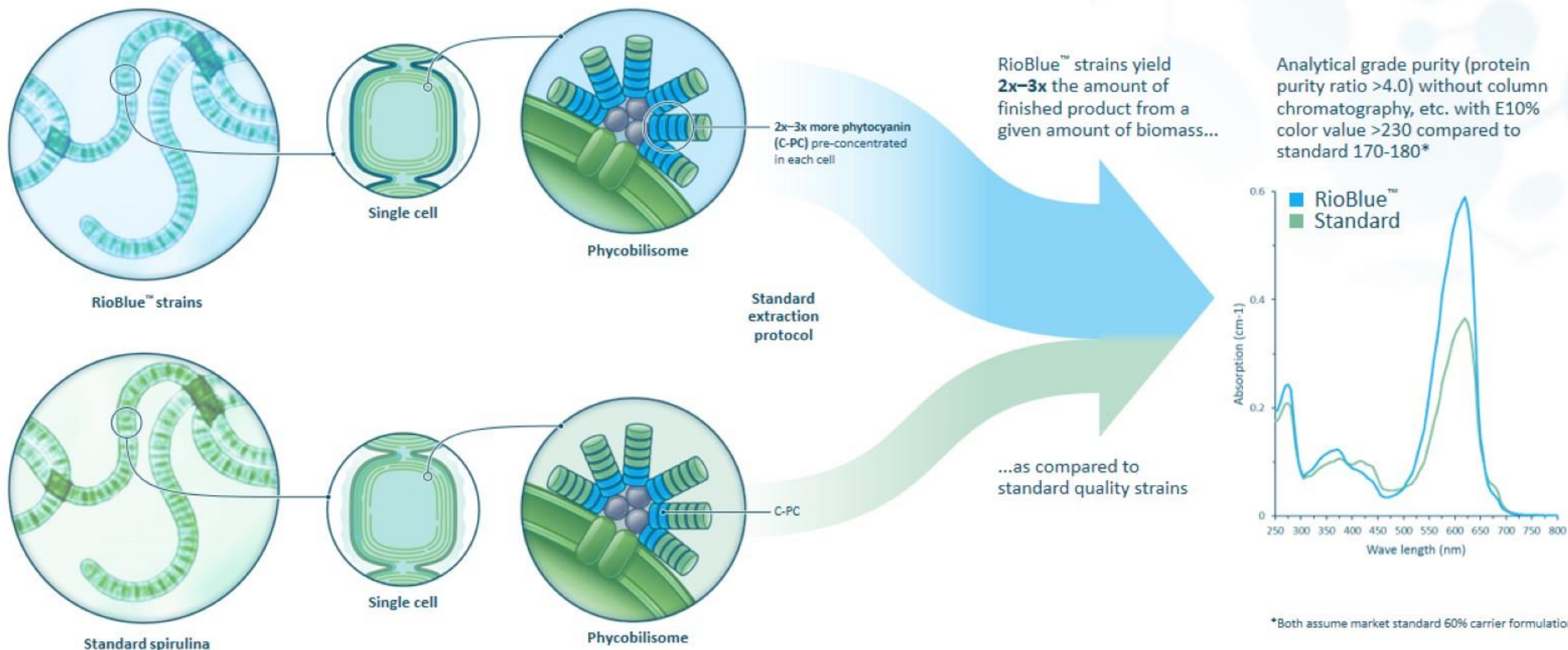


CIE 1931 XYZ color space chart

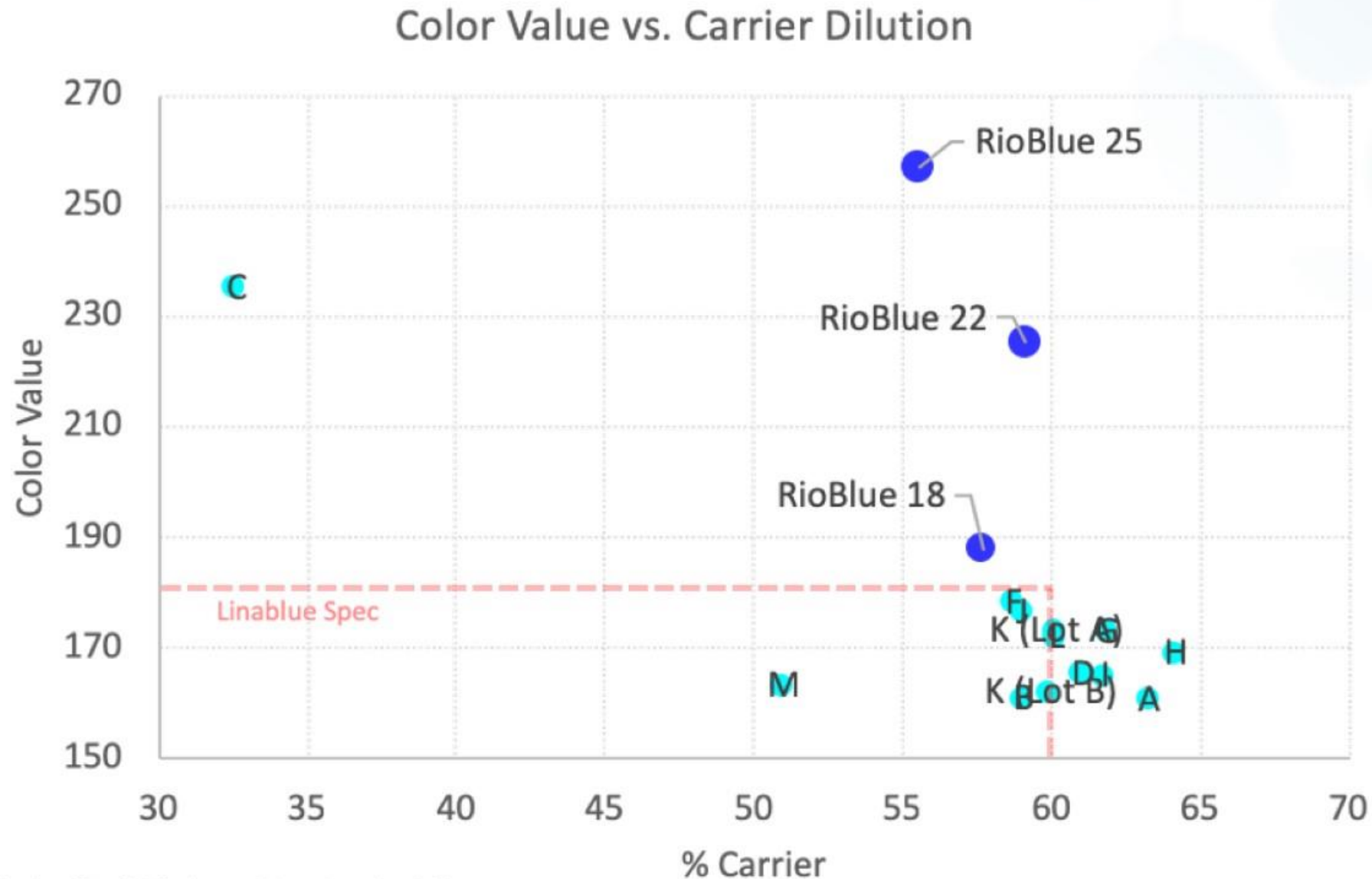


Biotechnology

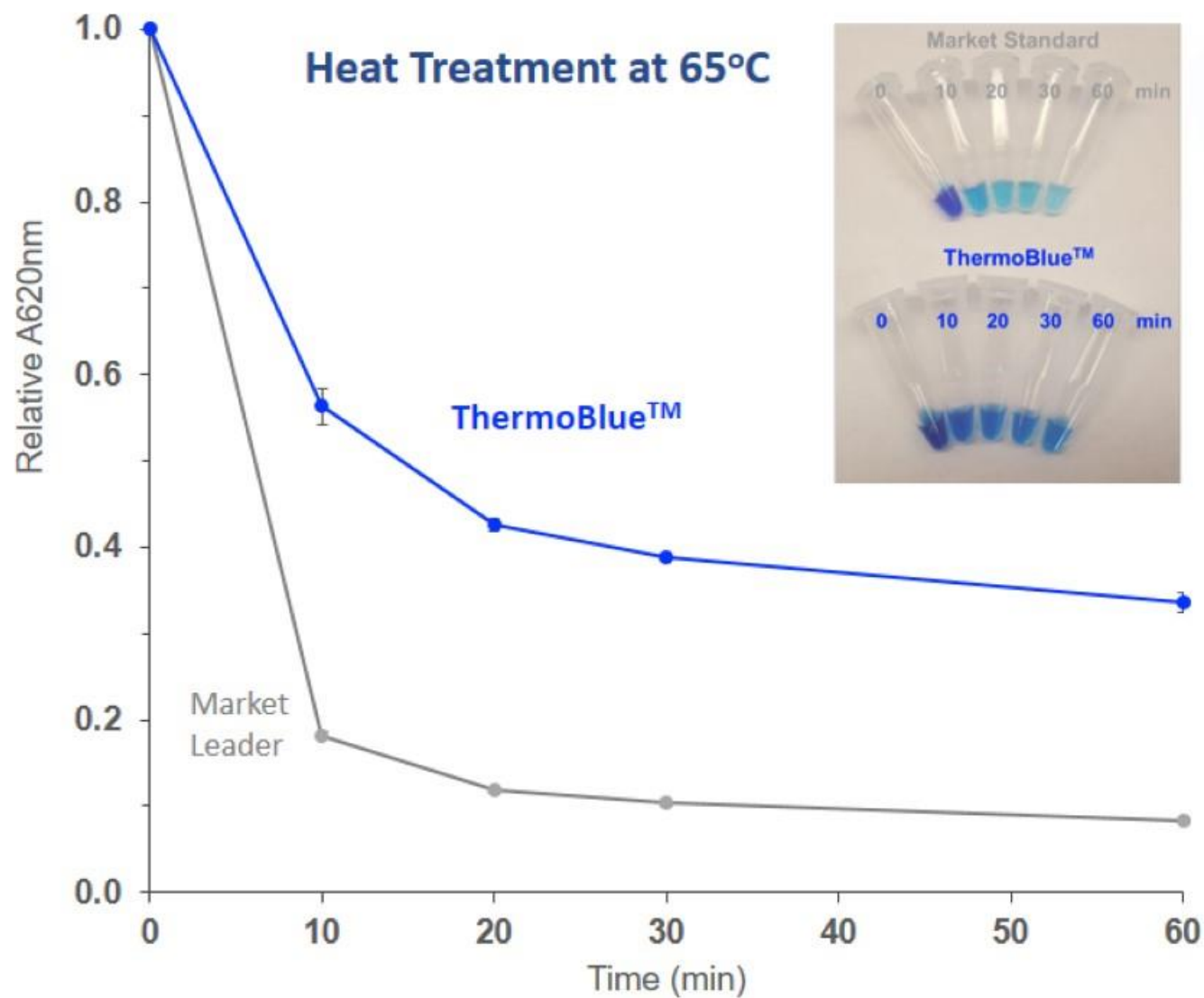
Lumen's Spirulina extract: both better and cheaper



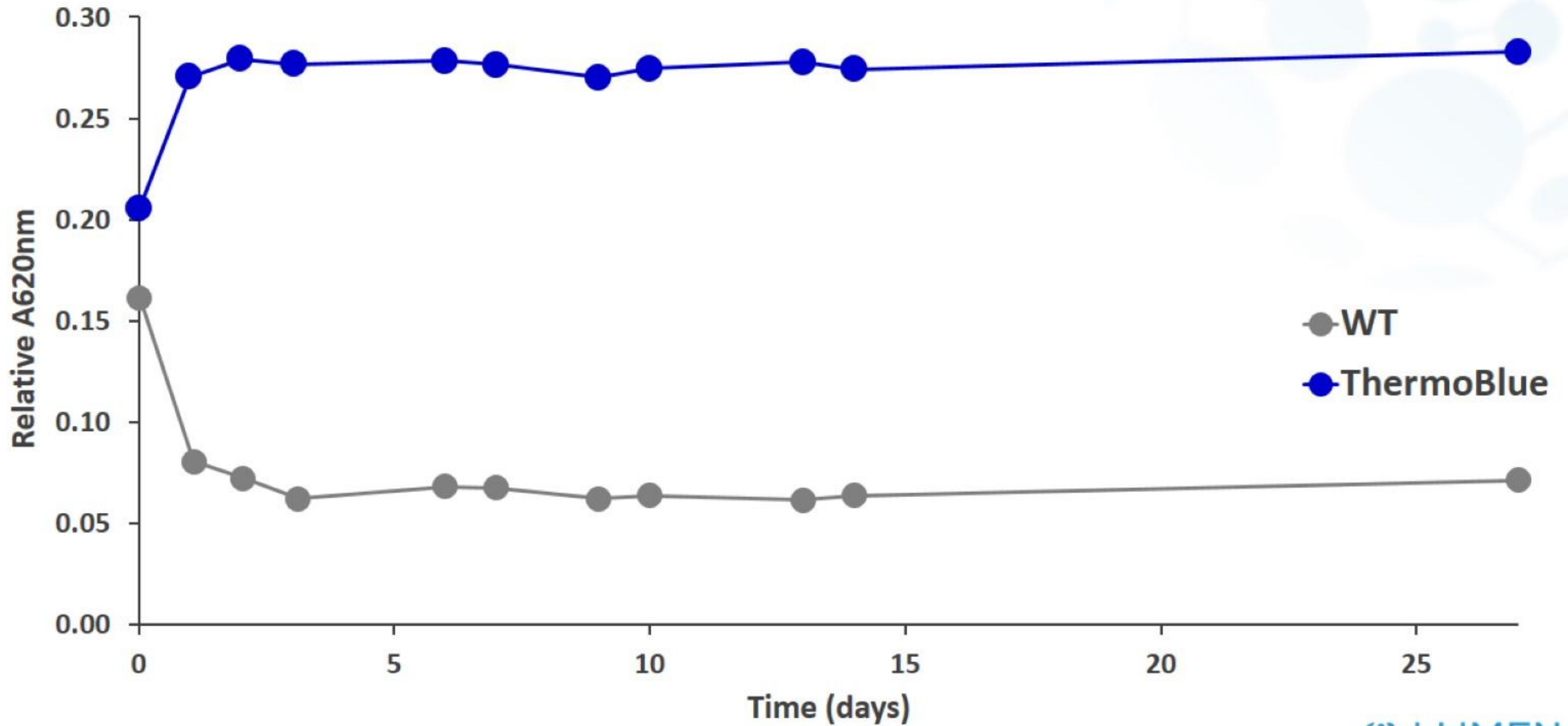
Comparison of commercially available spirulina extracts



Temperature Stability



pH stability



Other colors

- Other pigments are naturally abundant in Spirulina

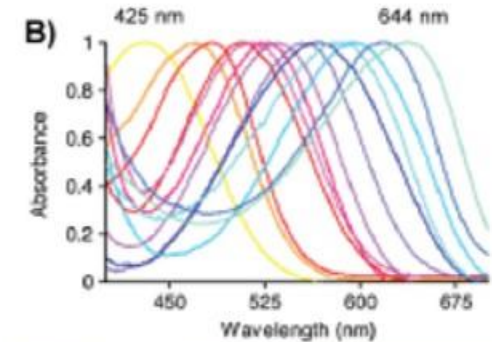
- E.g. allophycocyanin



- Modifying phycocyanin to yield entirely new colors

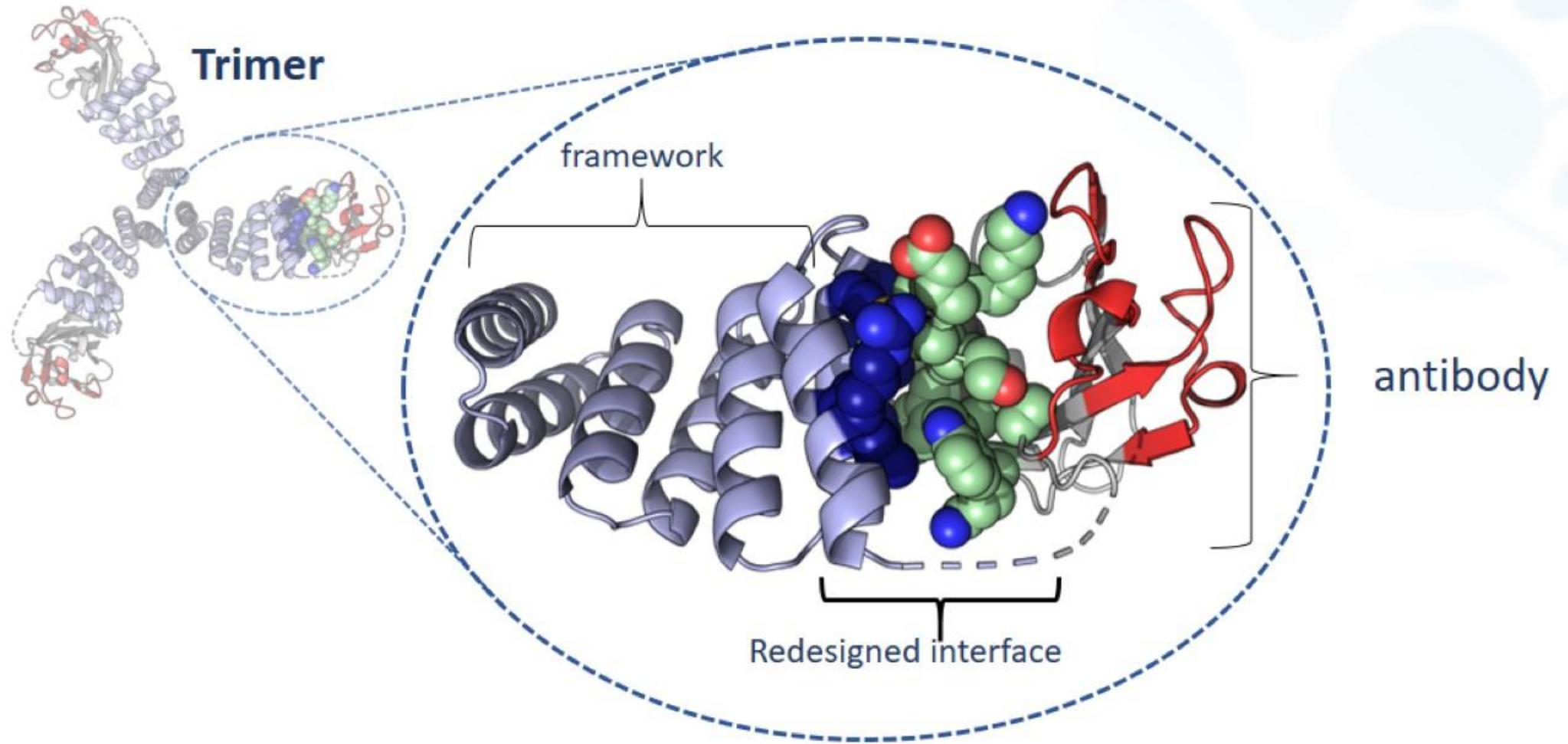


Lumen Bio Data



Published results in a model system
in a related field

A computationally designed and synthetically constructed antibody



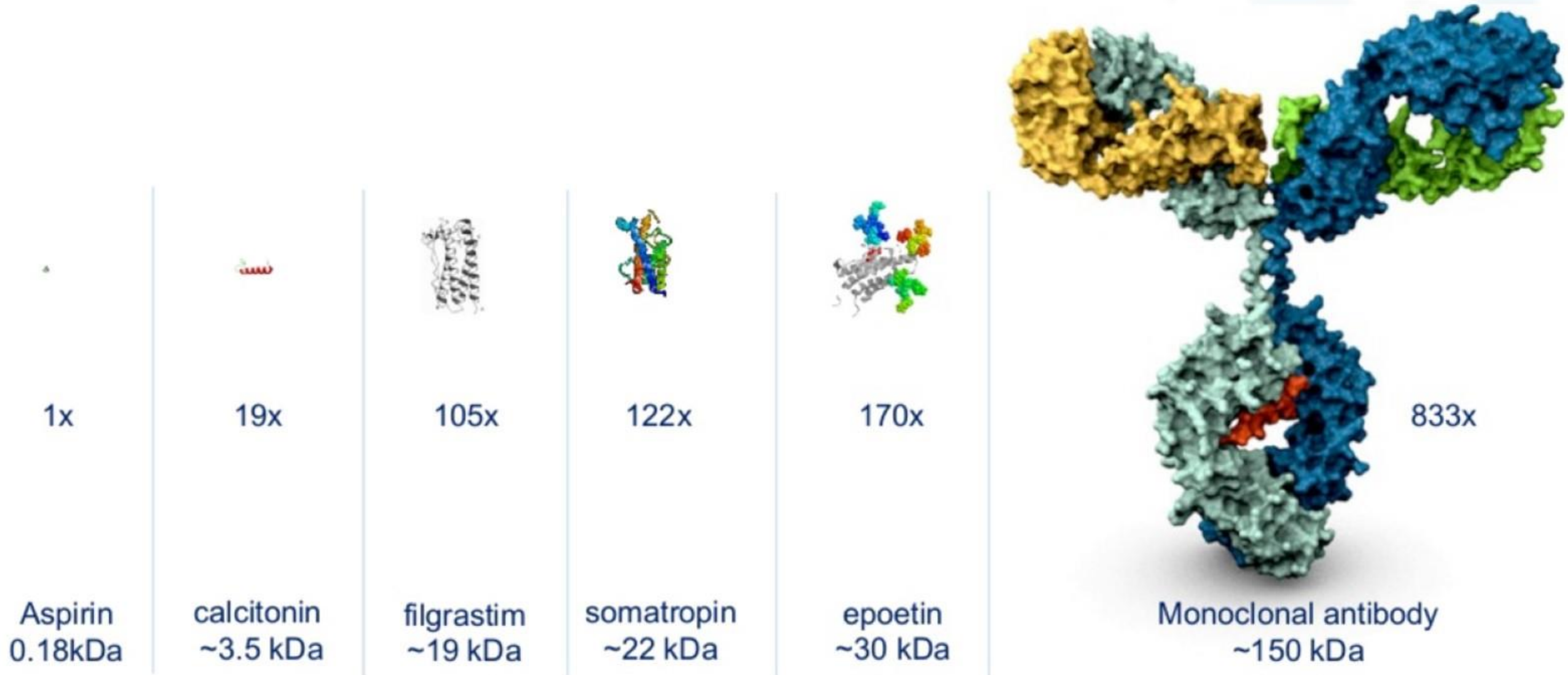
Safety/toxicology evaluation for Phase 1 human trials

- ICH guidelines:
 - 1 animal study (mouse okay)
 - No non-human primate studies
 - No immune histochemistry
 - Drivers:
 - Macromolecule orally delivered, non-human target
 - No articulable theory of toxicity

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- Current clinical practice:
 - Direct to Phase 2b clinical trial
 - Leading study: Ph2b in severely diuretic infants (rotavirus VHH)
 - Johns Hopkins: “Why would you waste time on a Phase 1 trial?”

What are biologics?

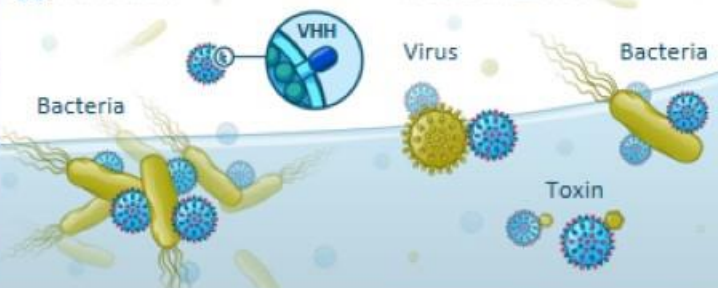


SMALL INTESTINE

Villi

Agglutination

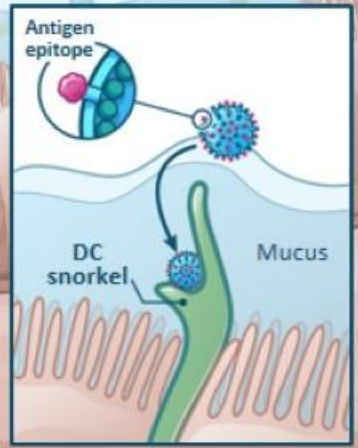
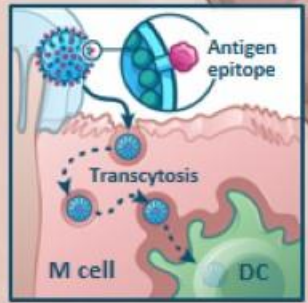
Neutralization



ANTIBODIES (PASSIVE IMMUNITY)

Nanoparticle-presented antibodies bind targets in the gut lumen to block pathogenesis

Multimeric nanoparticles



VACCINES (ACTIVE IMMUNITY)

Antigens presented in the gut lumen are sampled in various ways by immune system

ORAL VACCINES CAN GENERATE A SYSTEMIC IMMUNE RESPONSE

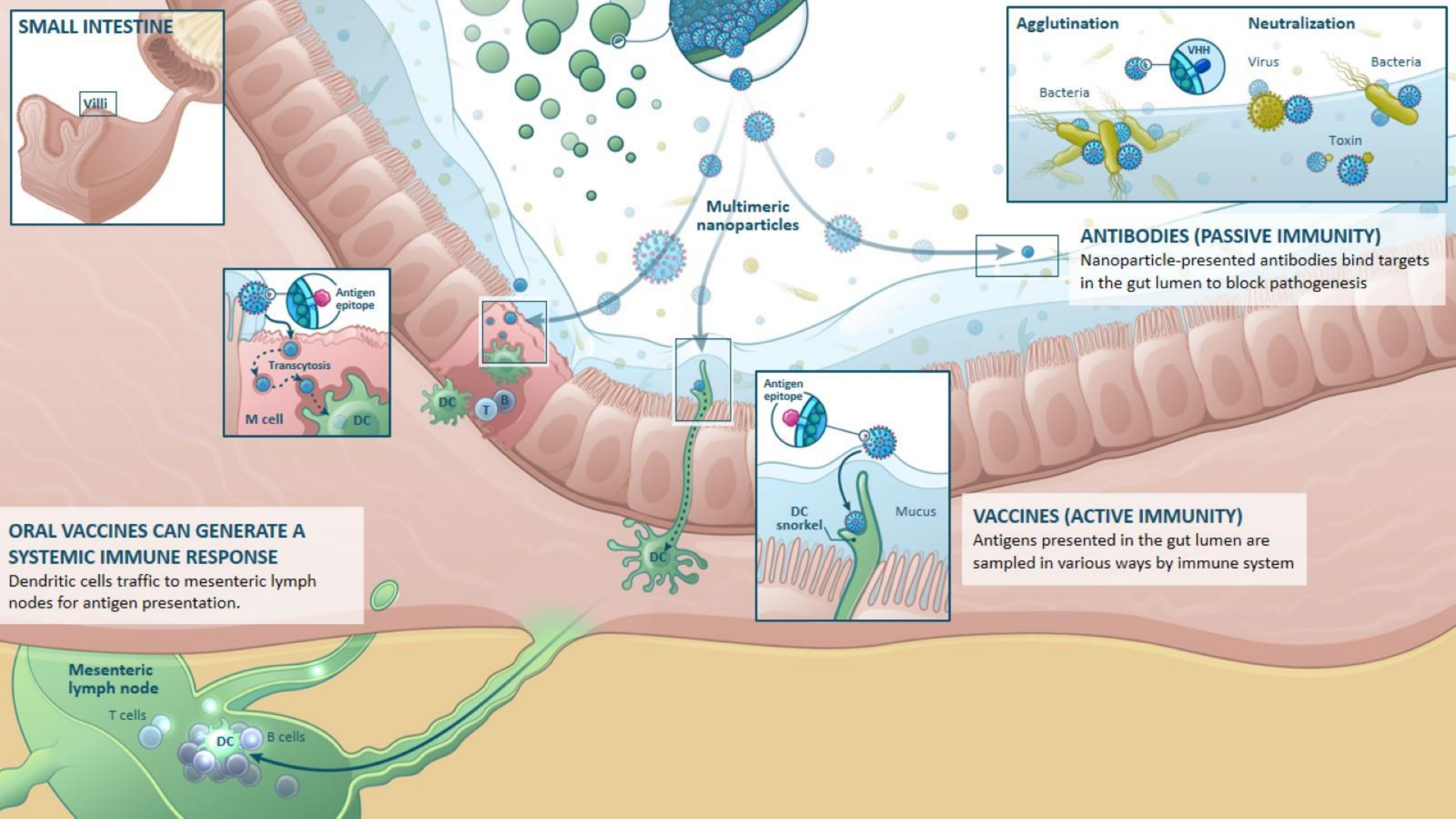
Dendritic cells traffic to mesenteric lymph nodes for antigen presentation.

Mesenteric lymph node

T cells

DC

B cells





We can.



We can.

Should we?