# Accelerating AIDD Validation: From Sequence to Quality Data in 4 Days

Hanying Luo, Ph.D. | Daniel Bedinger, Ph.D.




GenScript
Scripting Possibilities

# Science Moves Globally. So Do We.




**Global Presence**
US, Europe, APAC

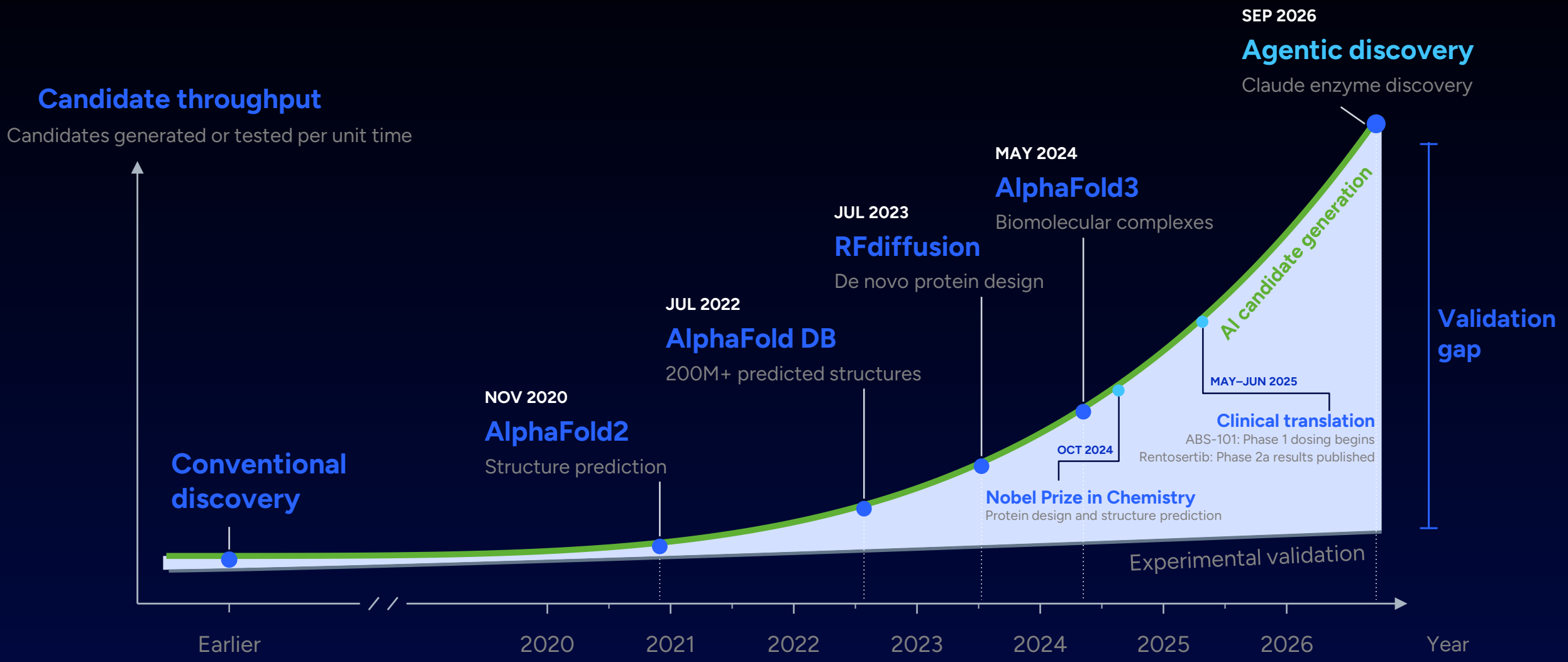
**Services**
100+ countries and regions, 200,000+ customers

Regional offices and logistics centers

Research and manufacturing sites

*As of June 30, 2025

# AI Is Reshaping the Drug Discovery Paradigm



# AI built up a reservoir, but the floodgates are still closed

AI models are generating a massive backlog of unverified designs because wet labs are too slow.

# Model Only Improves as Fast as the Validation Loop

"Every week spent waiting for wet-lab results is a week our model isn't learning."

## Limited Throughput

AI generates 100,000+ designs/cycle





## Validation Takes Weeks

Typically 3–6 weeks

## Fragmented Workflows

Handoff errors, inconsistent formats, and accountability gaps at every junction





## Data That Isn't Model-Ready

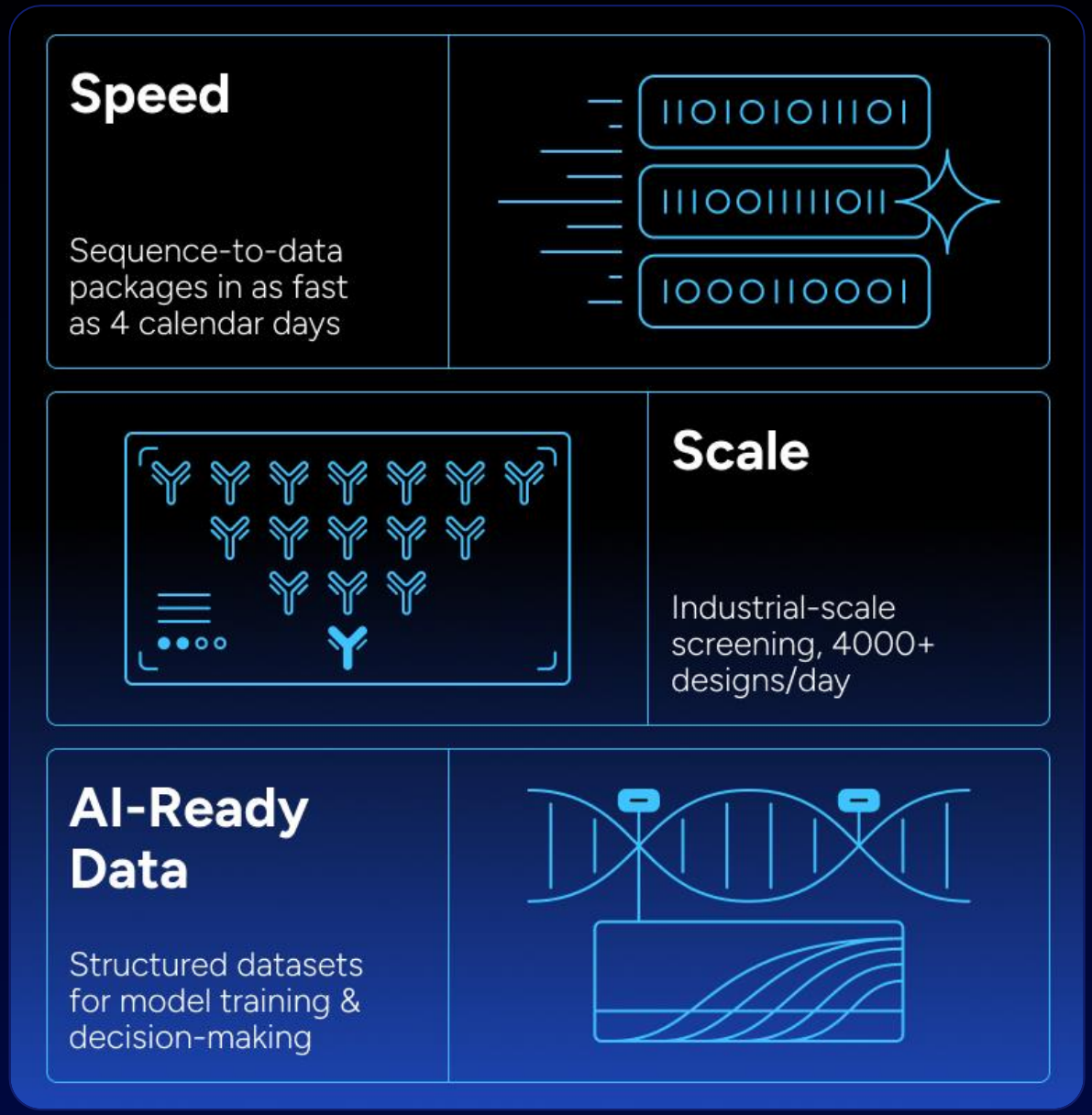
Reports are not always normalized, linked, or ready for retraining.



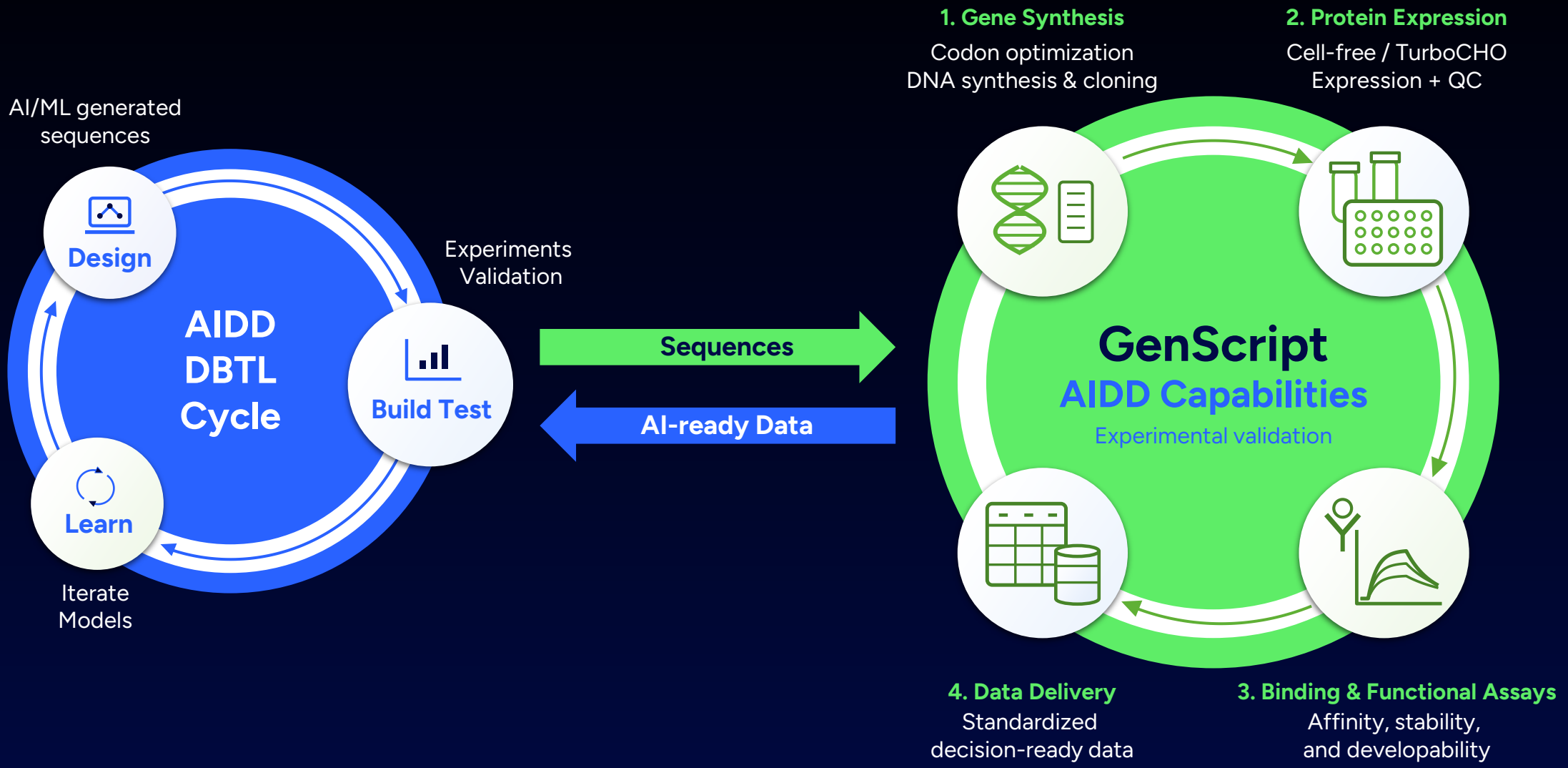
**The Need:** A **scalable validation engine** that **compresses DBTL loops** while preserving **data quality.**

# Closing the AI Discovery Loop with Biological Validation

From sequences to model-ready data in only **4 days**, for faster and confident decisions.



# The Validation Engine for AI-Driven Discovery



# Faster BUILD: High-throughput AI-first Expression

## Sequences to proteins through modality-matched platforms

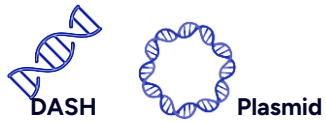
### Optimize

**GenSmart codon optimization** for expression, stability, and developability.

GenSmart®

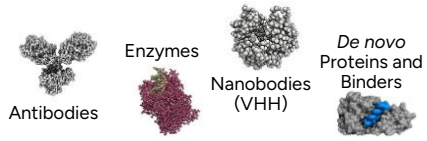
### Build DNA at Scale

High-throughput synthesis of production-ready constructs in **various modalities,** including linear DNA (DASH) & plasmid DNA.




### Express by Modality

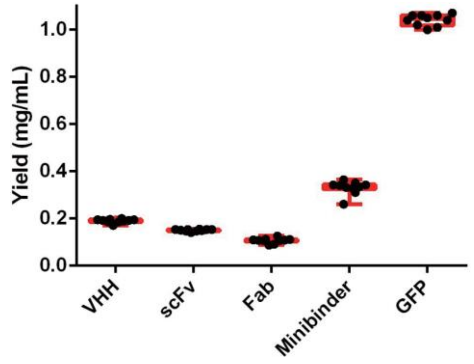
Route each construct to the **right platform** based on speed, yield, and protein format.




| Platform | Scale | Timeline |
|---|---|---|
| **Cell-Free** | 384-well plate | **3 CDs** |
| **TurboCHO** | Dark lab expression 1–4 mL | **5 BDs** |
| **E. coli** | 4 mL | **5 BDs** |

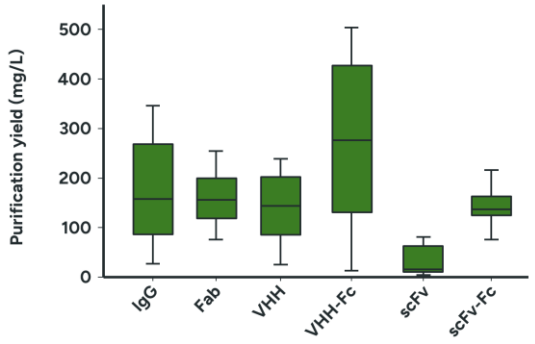
### Cell-Free Expression: High Yield at Screening Scale

**1 mL Scale**




### TurboCHO™: High-Yield Transient CHO Expression

**1 mL Scale**

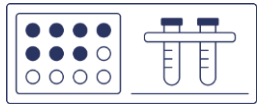


# Faster TEST: High-Quality Data at Scale

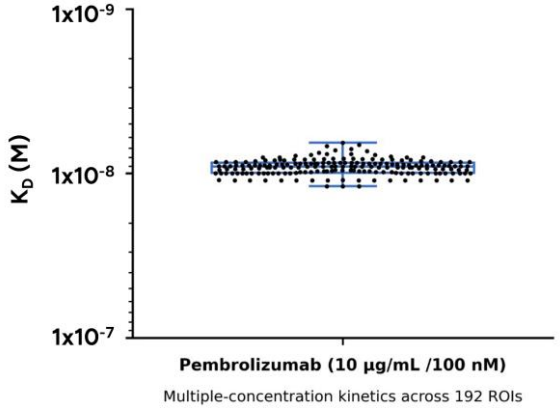
## Automated assay workflows delivering reproducible data: as fast as 2 BDs

### Industrial scale assays

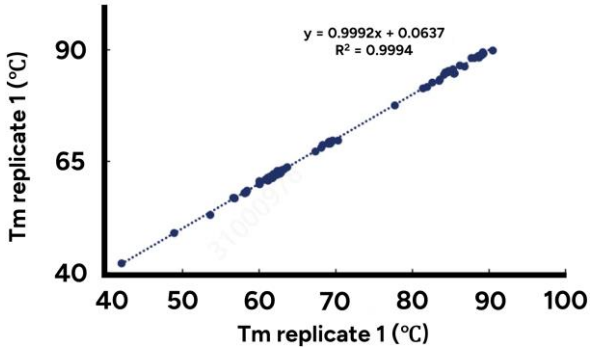
2-day for any combination | Scalable to 4000/day

| Affinity Binding | Biophysical Assays | Polyspecificity & Others |
|---|---|---|
|  |  |  |
| **Affinity Ranking** (Carterra HT-SPR, BLI, SPR 1-pt) | **Thermal Stability** (nanoDSF) | **Polyspecificity** (BVP, PAIA-OVA-Fc, PAIA-HEP-Fc, DNA-ELISA, OVA-ELISA, Insulin-ELISA) |
| **Full KD** (Carterra HT-SPR, BLI, SPR 5-pt KD) | **Colloidal Stability** (DLS, SLS) | |
| | **Hydrophobicity & Solubility** (HIC-HPLC, PAIA-HIC) | |
| | **Charge Variants** (icIEF, CEX-HPLC) | **Clearance** (FcRn binding at pH6.0/pH7.4) |
| **Cell-Based Binding** (FACS) | **Aggregation** (AC-SINS) | |

### Consistent Binding Kinetics at Scale




### NanoDSF Tm Reproducibility



# Smarter TEST: From Experimental Data to AI-Ready Data

## Decision-ready data

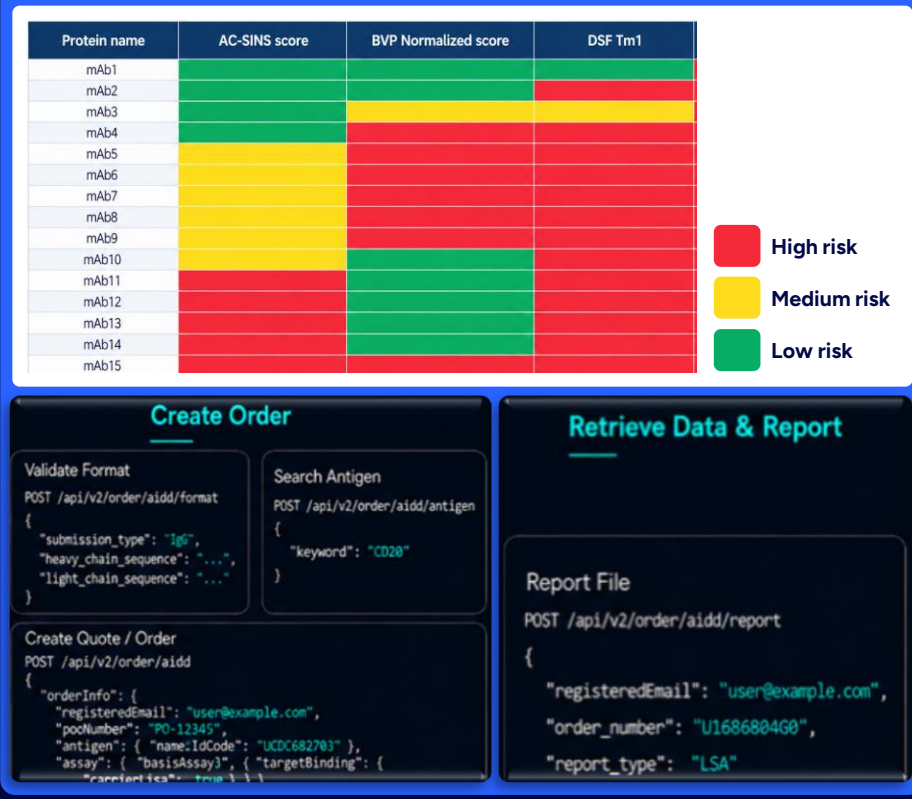
Standardized, AI-Ready datasets




| Data Type | Examples |
|---|---|
| Raw Data | Instrument output, curves, assay readouts |
| Processed Data | Rankings, KD values, QC summary, flags |
| Metadata | Sequence ID, sample ID, target, expression route, assay condition |
| Delivery | Standardized table, API-ready export, ELN/LIMS-ready format |

## Powering AI Applications

Ready for model training, analysis, and design



# The Validation Engine for AI-Driven Discovery

Velocity, capacity, data quality, and cost efficiency in one execution engine

**20M+**
AI-Ready Data Points Generated per Year

**600K+**
AI-Designed Proteins Expressed per Year

**<$10**
Per AI-Ready Data Point

**3500+**
Global Partner Organizations

**260K+**
Proteins Assayed per Year

# Collaborating Within the AI Discovery Ecosystem

GenScript BioTechCorp. | Lilly TuneLab™

GenScript Joins Lilly TuneLab to Advance AI-Driven Drug Discovery

GenScript BioTechCorp. | Tamarind Bio

GenScript and Tamarind Bio Partner to Connect AI Molecular Design with Rapid Lab Validation

# Bring the Execution Engine In-House

Accelerate sequence-to-protein workflow with industrial scale solutions in your lab

## Gene Synthesis

### Flash Gene - 4 BD
- Sequence-to-plasmid in 4 days
- High-throughput

### DASH DNA (Cell free) – 3 BD
- Transfection-ready DNA fragment

### Fragment 2.0 – 3 BD
- DNA Polymerase & Ligase-Free Cloning
- GenBuilder™ Cloning Kit

## Expression

### TurboCHO™ Kit – 5 BD Harvest
- CHO K1-based mammalian expression
- Harvest in 3-7 days vs 10+ days

### Cell-Free Kit – 1 BD
- Same-day expression from DNA to functional protein




## Purification

### Magnetic Beads / Protein A
- High binding capacity and purity

### Automated & Scalable Workflows
- From bench-top to HTP purification



- Placements in all Top 20 Pharma, by Revenue
- >200 Platforms in the Field: LSA, LSA$^{XT}$, and Ultra
- 15 Technology Patents
- 5 Customer Experience Centers Around the Globe
- Headquarters in Salt Lake City, Utah

carterra®

carterra®

# Carterra's Product Solution

## Biosensor Instruments



LSA



LSA$^{XT}$



Ultra



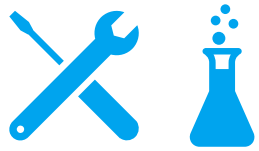
Vega




Control and Analysis Software



Biosensor Chips and Consumables

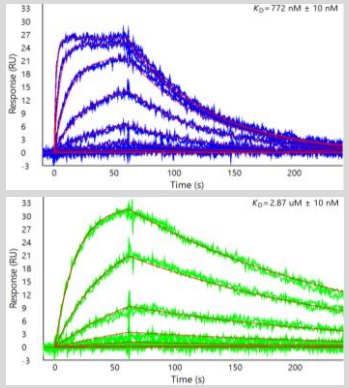


World Class Service and Support

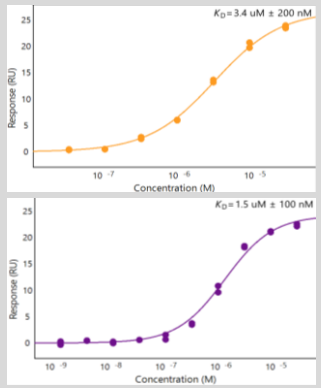
**Carterra now offers the highest throughput and most capable assay platforms for any SPR application**

# Full Range of HT-SPR Applications

## Small-molecule Analyses

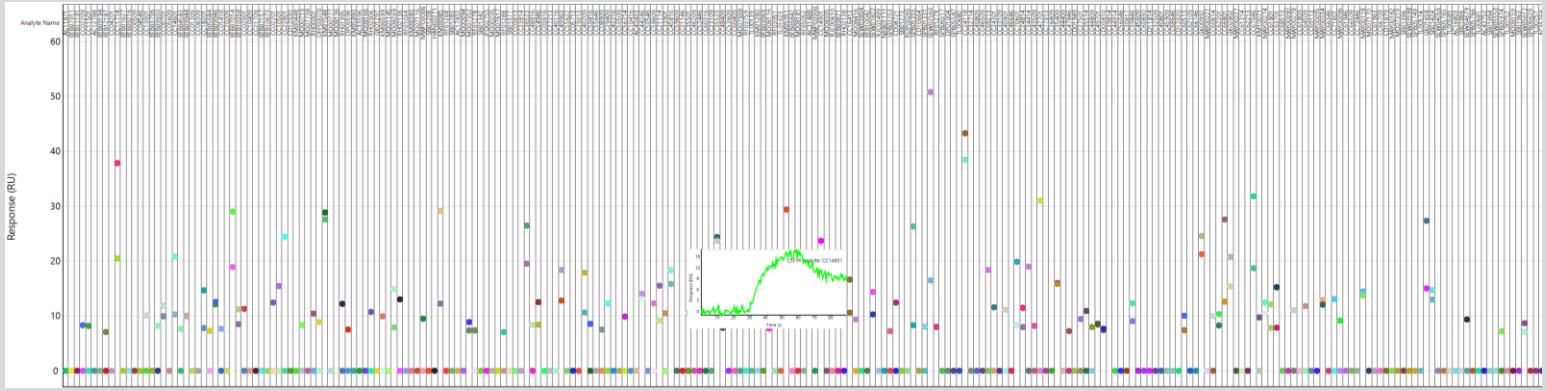



kinetics



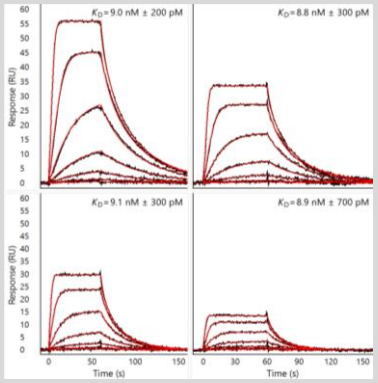

steady state

## Fragment Screen

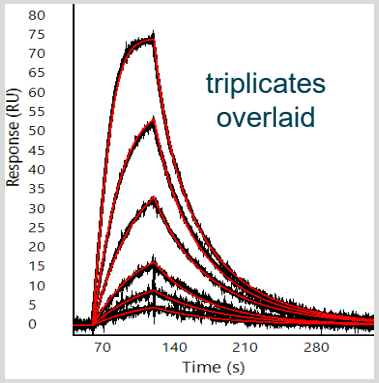



hit identification and target selectivity

## Large-molecule Kinetics

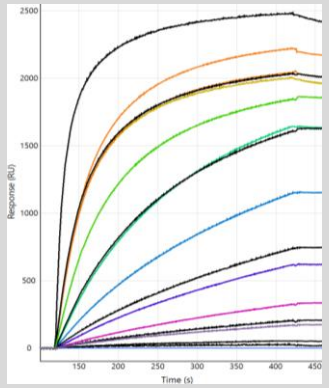



Ligand density

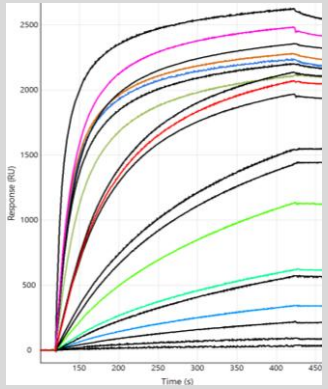



parallel analysis

## Quantitation

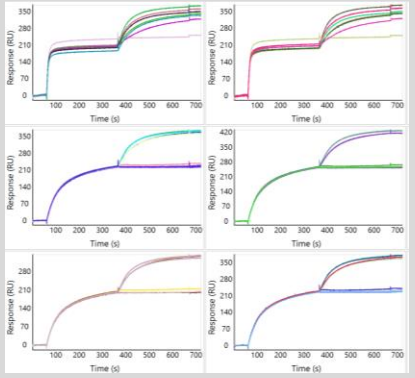



serum

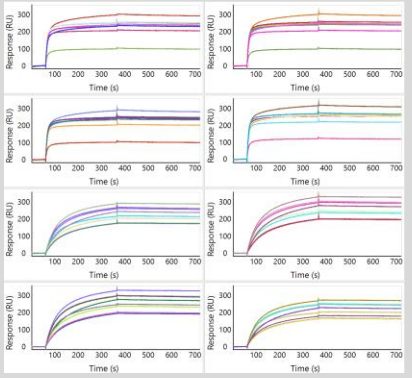



mock cell lysate

## Epitope Binning




classical




premix

# Carterra positioned at the center of lab-in-the-loop discovery

- Recent Wall Street analyst coverage by William Blair & Leerink Partners
  - Both position Carterra's high-throughput SPR as core validation infrastructure for wet lab validation of  AI pipelines

- Huge demand at CROs for rapid cycles from sequence to binding kinetics
  - Timelines for sequence to HT-SPR analysis are targeting 4 days or less for hundreds to thousands of clones
  - Genscript has tremendous capability to generate high volume HT-SPR data

GenScript
Scripting Possibilities

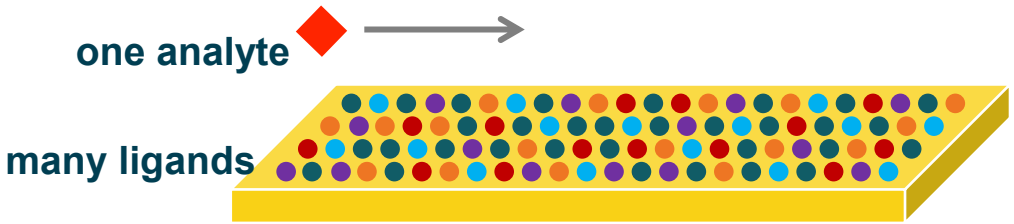
  - An LSA-XT can measure 1152 clones per day/platform
  - Low antigen consumption
  - Automation

# Carterra's suite of HT-SPR platforms

## One on Many



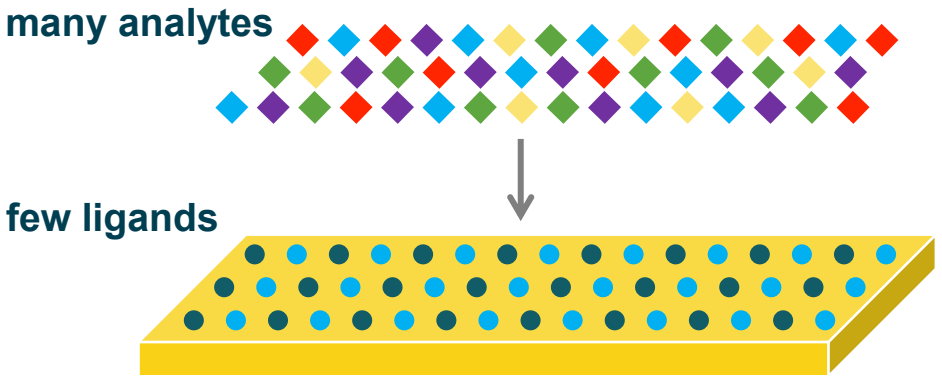

LSA LSA$^{XT}$ Ultra




## Many on Few




Vega



# Meet Carterra Vega™

## The New Benchmark in High-Throughput Kinetics and Screening “Many-on-Few”

- **48-Channel platform**: Enables screening of 2 ligands AND a reference in each channel
- **Speed**: 20 minutes per 384 well plate
  - Full kinetic profile injections
- **Automation**: Integrated plate loading robot option
- **Throughput**: Screen > 20,000 analytes in a day
- **Sensitivity**: Analyte analysis down to 100 Dalton
- **Flexibility**: Enable screening and kinetics in one workflow

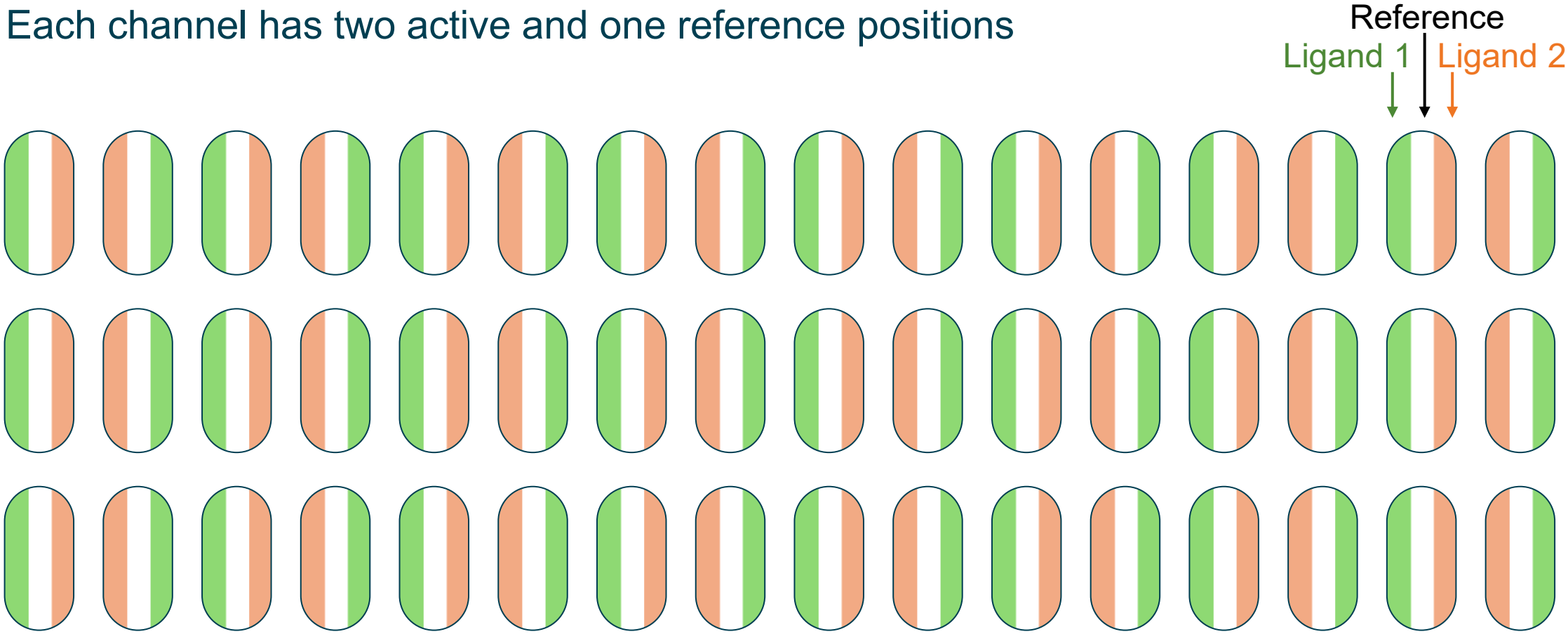


# 48 Channels- Two Ligands and One Reference per Channel

**Parallel Analyte Injections**

- 48 Needles/Channels
- Each channel has two active and one reference positions

48 over 2
Channel Layout




carterra

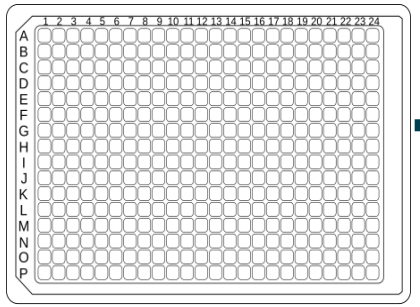
# Vega Automation



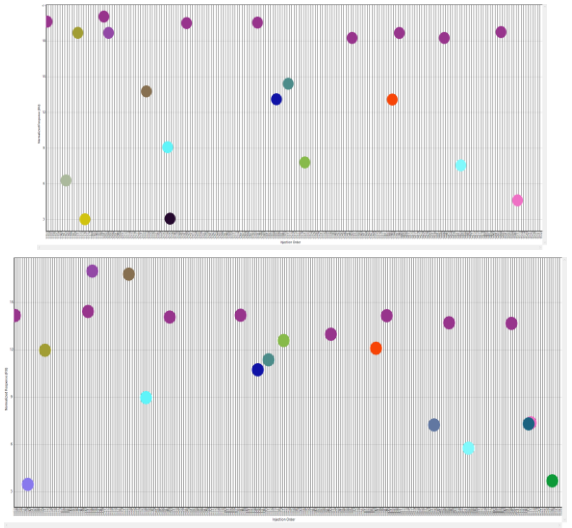
Optional automation capacity up to 105 plates

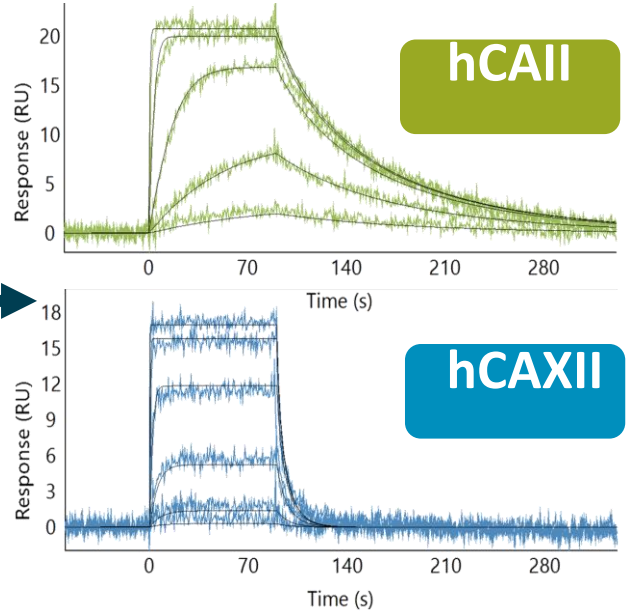
Integrated bar code scanning

# Example of the Classical Screening and Kinetic Profiling Workflows




**Library**





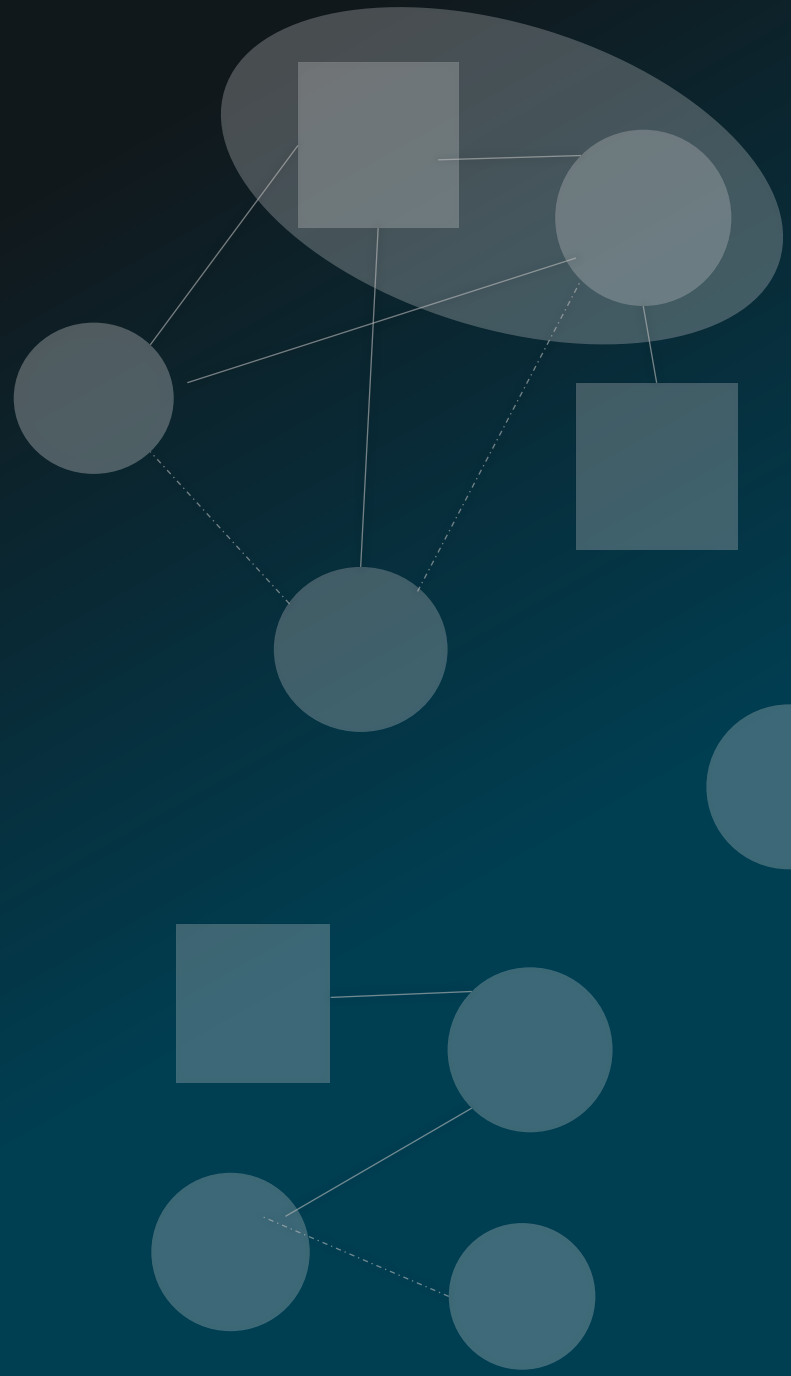

## Single Point Screening

- 384 Analytes
- Two Targets
- Single-concentration sensorgrams
- 35 Minutes - 30 second phases

## Kinetic Profiling for Hit Validation

- 48 Analytes
- Two Targets
- Full kinetics concentration-series
- 1.2 Hours – 90 second association, 5 minute dissociation

# AIntibody Study



carterra

nature biotechnology
11/2024

# AIntibody: an experimentally validated in silico antibody discovery design challenge

- Prospective and blinded study
- Participants contributed sequences to three challenges
- mAb submissions expressed as full-length IgG
- Measured with uniform protocols by independent labs
- 510 AI-designed or AI-predicted antibodies from 29 organizations
  - academic/nonprofit, biotechs, large pharma, and big tech
- Study Participants:
  - NGS datasets from mAb selection against SARS-CoV2 RBD (Specifica)
  - Constructs, expression, and purification (Azenta)
  - Developability assay panel (Mosaic)
    - HIC, AC-SINS, BVP ELISA, $T_M$, $T_{agg}$
  - HT-SPR on LSA-XT for all sequences (Carterra)
  - KinExA on high-ranking clones (Sapidyne)

SPECIFICA
an IQVIA business

AZENTA
LIFE SCIENCES

carterra

mosaic

Sapidyne
Instruments

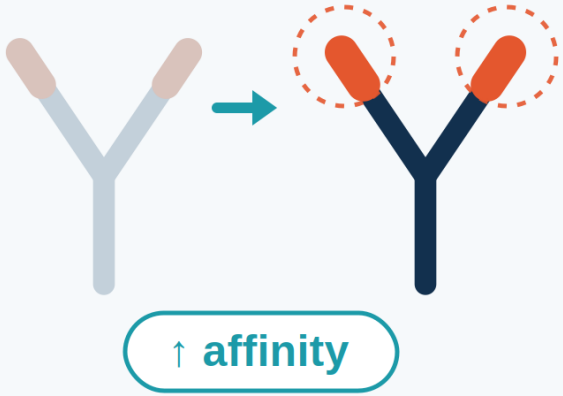
TQRCG

# The AIntibody Challenges

## • CHALLENGE 1

**In silico affinity maturation**

1

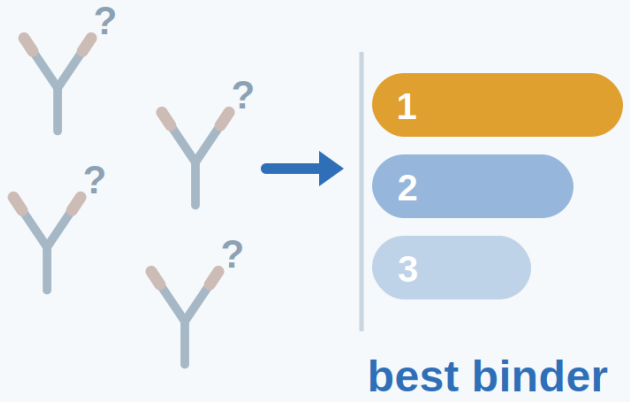



**Optimize the CDRs**

## • CHALLENGE 2

**In silico affinity rank prediction**

2

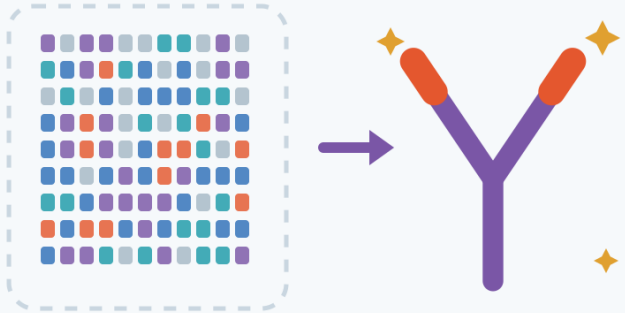



**Rank the unknowns**

## • CHALLENGE 3

**NGS-inspired computational Ab design**

3



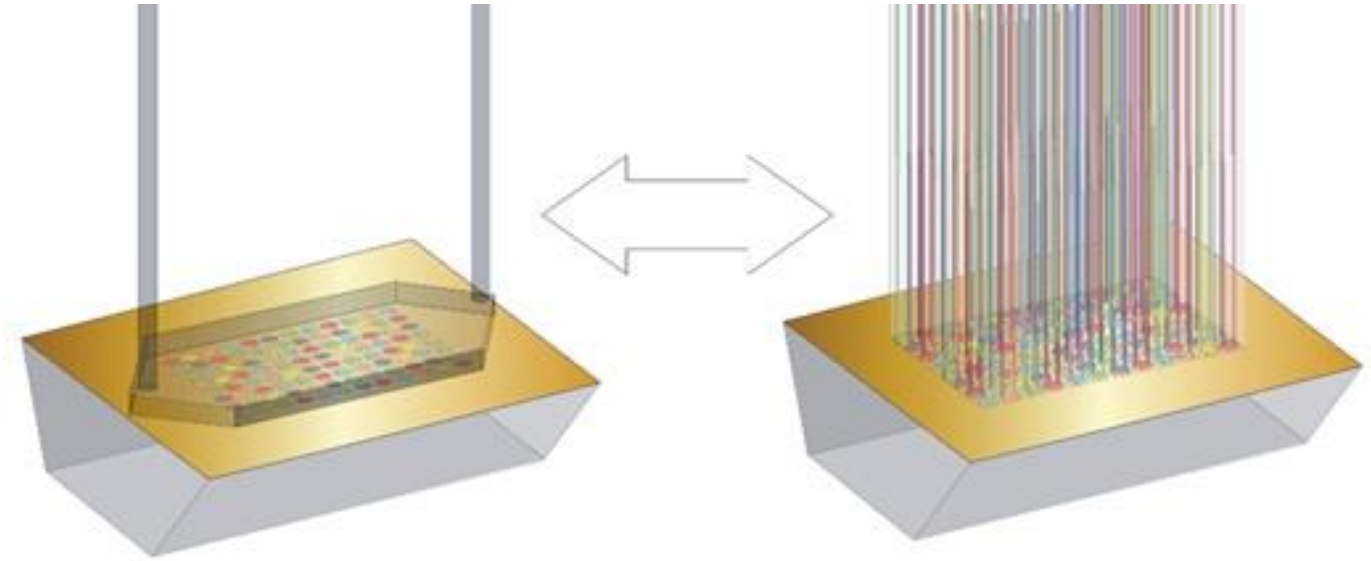

**Design beyond the library**

*Framework regions fixed — CDRs only | designs experimentally validated by high-throughput SPR*

# Novel microfluidics transform SPR

**Single-channel mode**
**(single flow cell)**

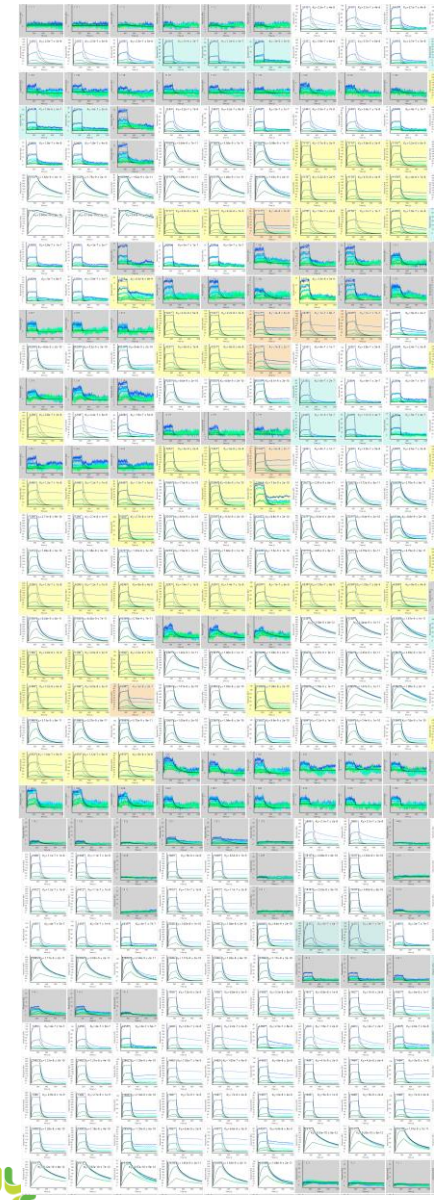
**Multi-channel mode**
**(96-channel flow-cell)**



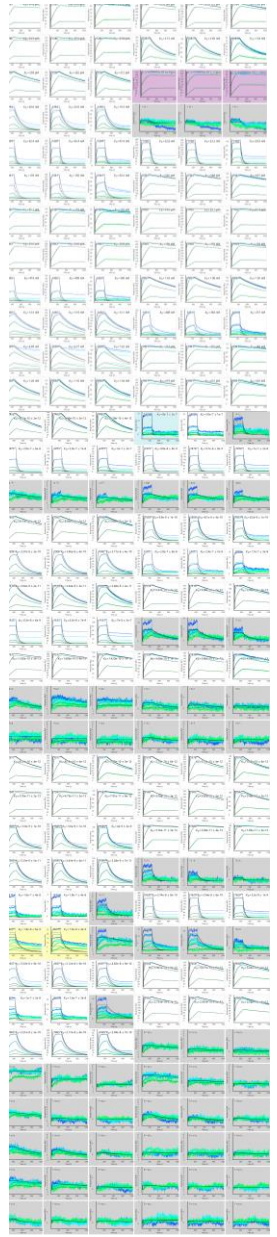
- Automated flow cell switching between multi- and single-channel modes
- 384 or 192 Ligands per array
- Minimal analyte consumption via “one-on-many” assay format

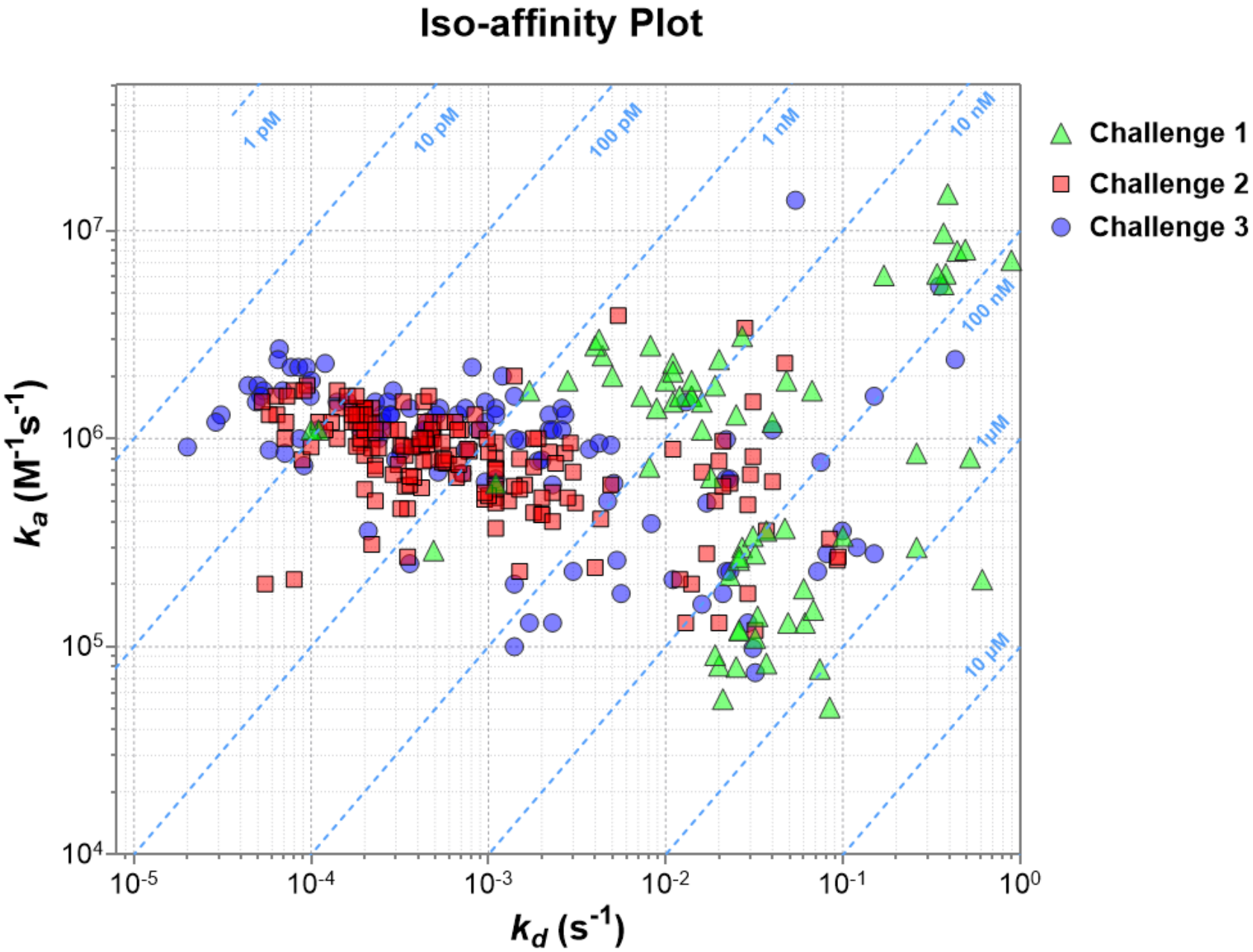
# AIntibody Challenge Analysis ≈1650 Analysis

Challenge 1

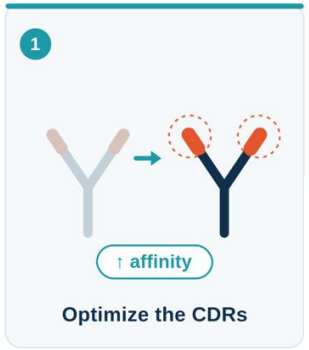


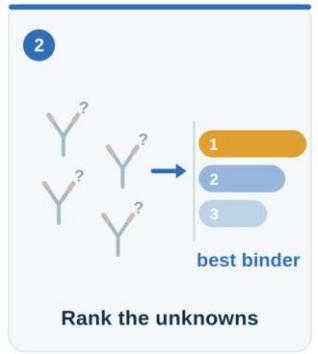
Challenge 3





# Results- Published Nature Biotech August 2026







- **Challenge 1  In silico Affinity Maturation**
  - Generally successful, 71.5% bound the target
  - ~13% of designs achieved ≥20-fold improvement
  - 63% passed developability tests
  - **AI matched but did not beat experimental display- best clone from Aureka**

- **Challenge 2 – In silico affinity rank prediction**
  - Roughly 10% of selected sequences had affinities better than the most abundant sequence
  - **AI selections were typically, worse than random selection** (WashU beat this at 50%)

- **Challenge 3 – De Novo Rational Design**
  - 70% were binders
  - 14.3% sub 100 pM
  - **Winner was 2.9 pM (Xencor), 2 mAbs had higher affinity than the best experimentally derived clone**

- **Clear overall trend for developability issues in higher affinity mAbs across the challenges**
- **Most successful models were PLM with contextual attention**


- DOI  https://doi.org/10.1038/s41587-026-03238-6

# An Ultimate Example of Lab in the Loop: Medra's Physical AI Scientist

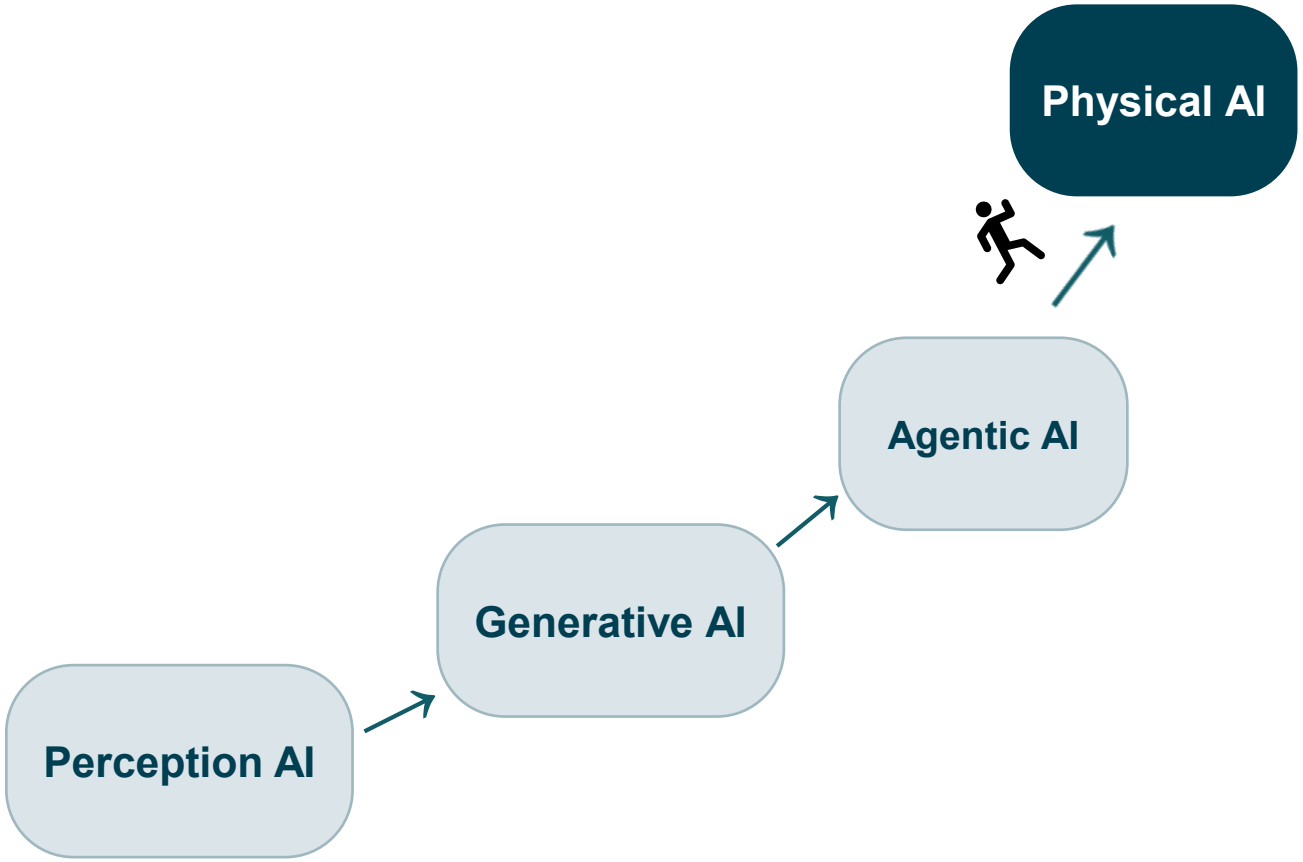


Medra

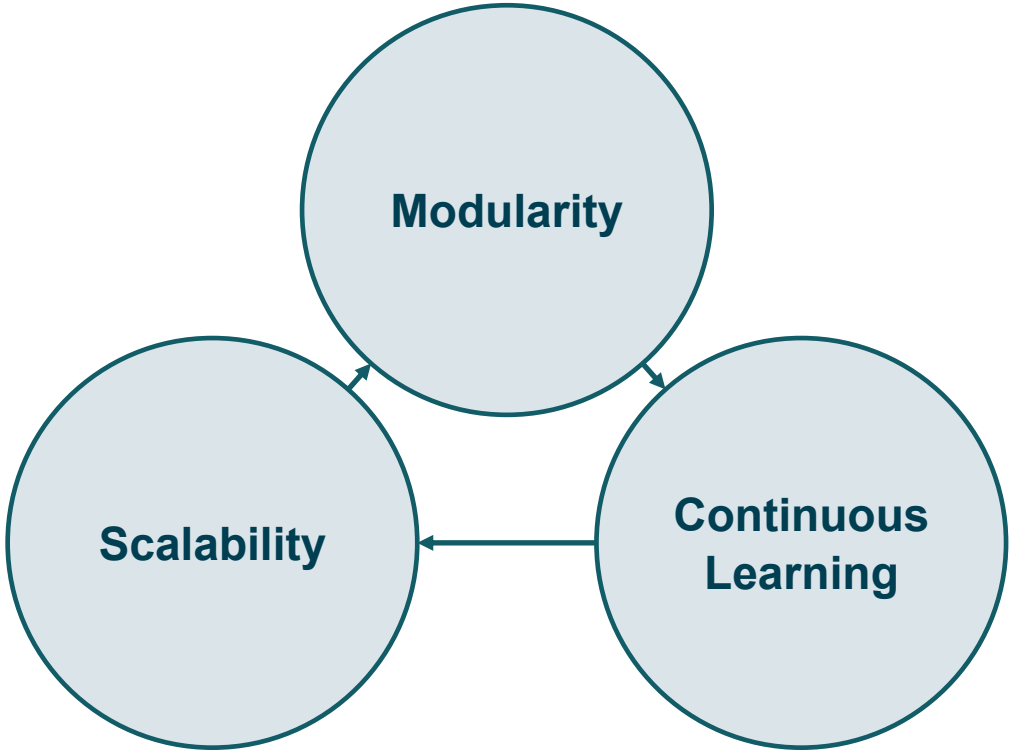
carterra

# The Physical AI Scientist

## THE AI CAPABILITY CURVE




## Physical AI Scientist Requires




Source: Medra.AI — Physical AI framework


**Physical AI Scientist:**
Designs, Executes, Analyzes, and Iterates

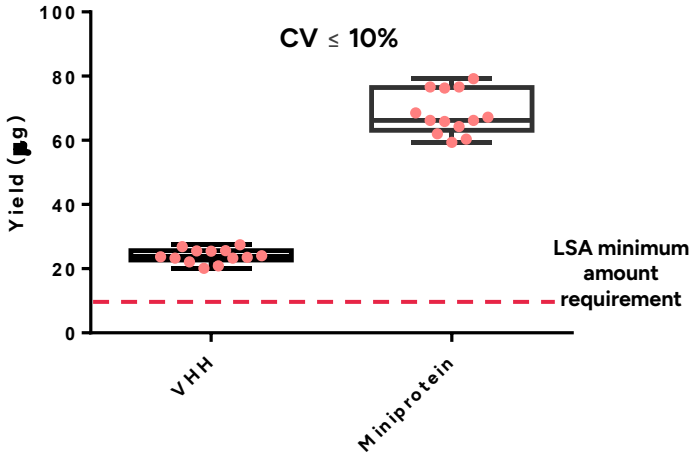
# Joint Case Studies

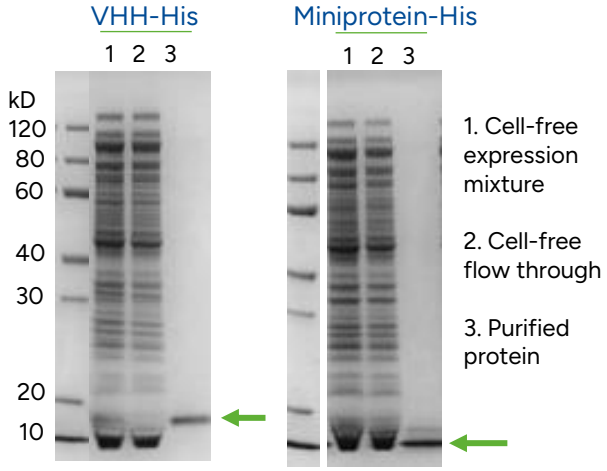
## From Sequence to Data in 4 Days: Integrating GenScript Cell-Free Expression with Carterra High-Throughput SPR

# 4-Day Sequence To Data With A Cell-Free Workflow



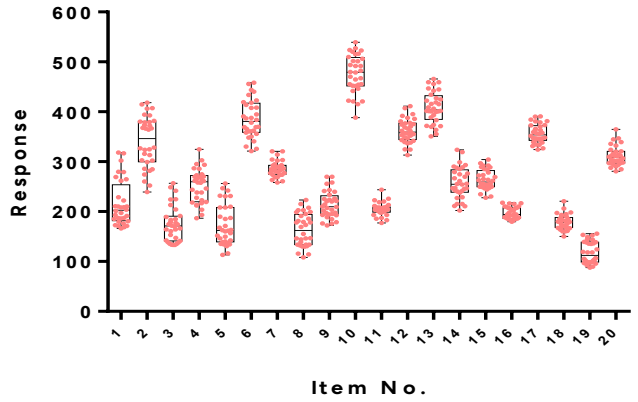

## 384-well Plate Cell-free Expression Yield




384-well plate cell-free expression platform delivers **consistent, reproducible yields across VHH and miniprotein samples**, providing **sufficient material for Carterra LSA binding assays**.

## Carterra LSA Performance




Signal response exhibited a **coefficient of variation below 25%**, demonstrating **chip uniformity and high reproducibility.**

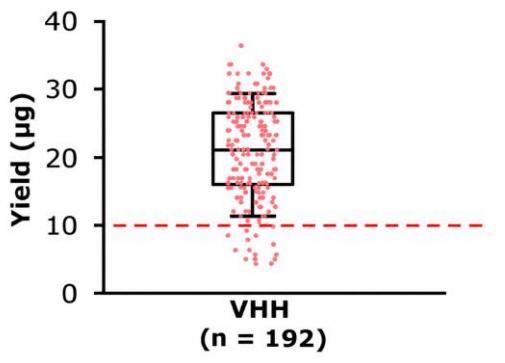
# AI Biotech Case:
# 4-Day Sequence To Data With A Cell-Free Workflow

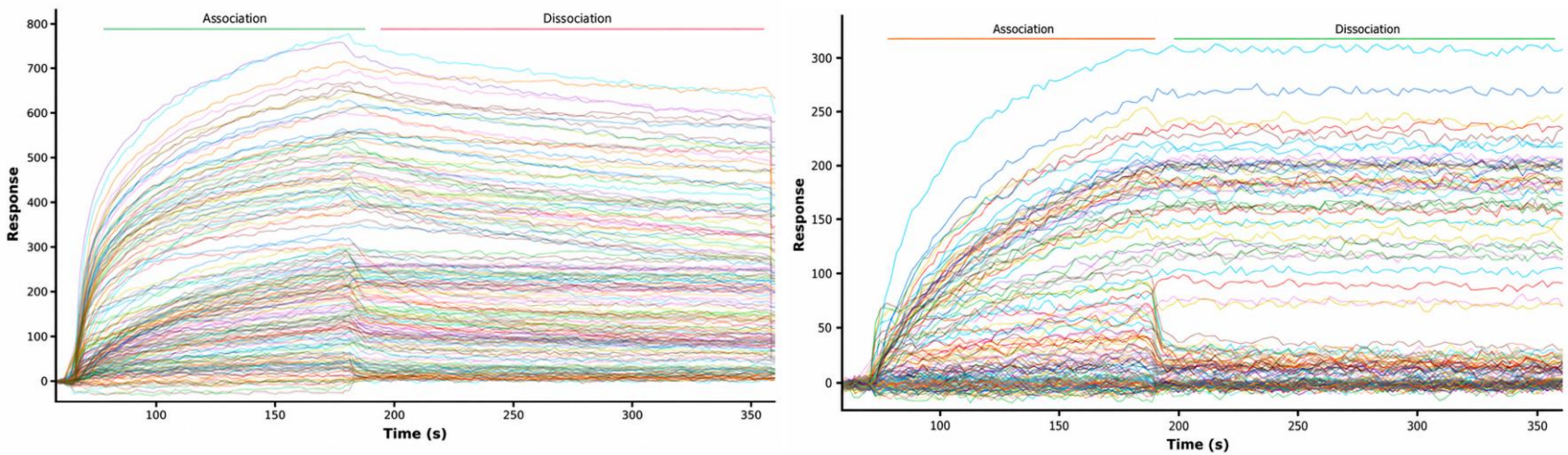
**192/ 100% delivered**
VHH Sequence

**Binding Screening**
Single concentration

**2 Species targets**
human + cynomolgus

**4 Days**
Data delivered




Representative sensorgrams showing binding profiles of 192 de novo-designed VHH candidates against the same target from two species: human (left) and cynomolgus monkey (right), demonstrating cross-species reactivity

# GenScript x Carterra

Generate AI-ready data at **speed** and **scale** with **ultra-fast protein** production and **quantitative HT-SPR** characterization.


COMING SOON
GenScript Life Science
Research Grant 2026
GenScript x Geodesic
Beyond Binding Challenge
AI Protein Design Meets Real-World Validation
$2.5M in funding, service credits, and cash awards
REGISTER YOUR INTEREST NOW
LEARN MORE AT BOOTH F11

# Thank You




GenScript
Scripting Possibilities