

1 Illicit Drugs and Roadside Accidents

- Driving under the influence of illicit drugs is a major cause of roadside accidents in New Zealand as well as globally, especially in the recent years.
- This can be restrained by implementing **routine roadside drug testing**.
- A reliable device which meets legislative requirements is currently unavailable.
- Development of a suitable **sensor** for easy, reliable drug testing is of prime interest.

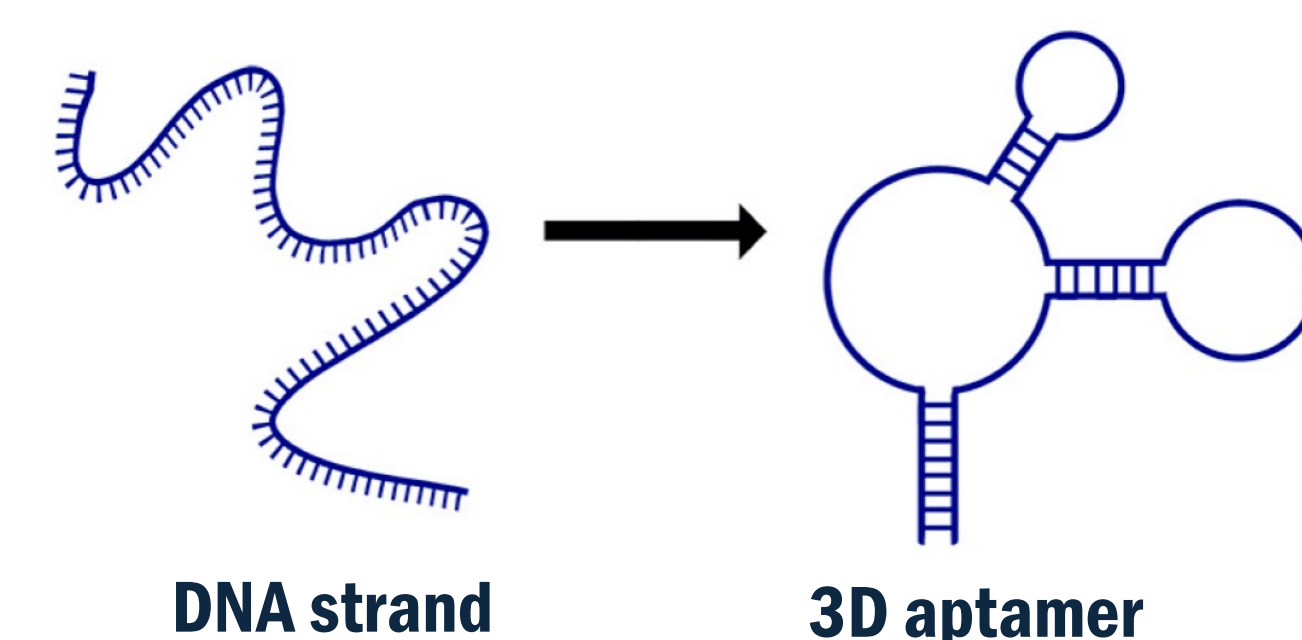


2 DNA Aptamers in Biosensors

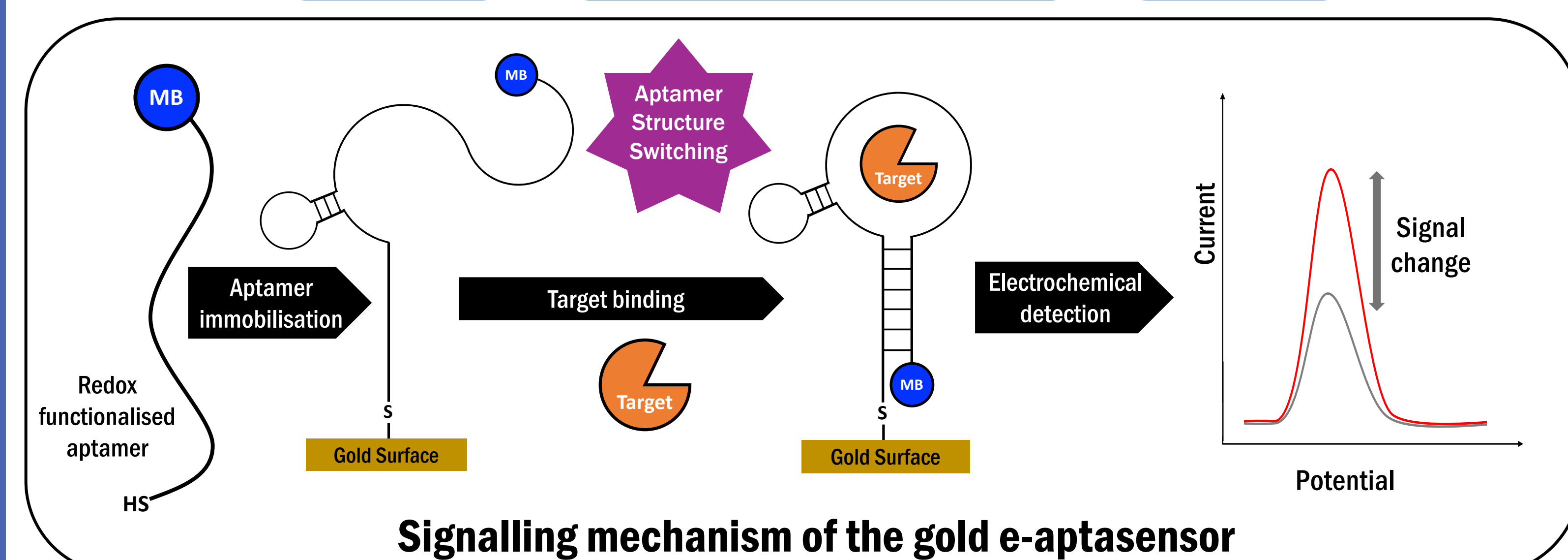
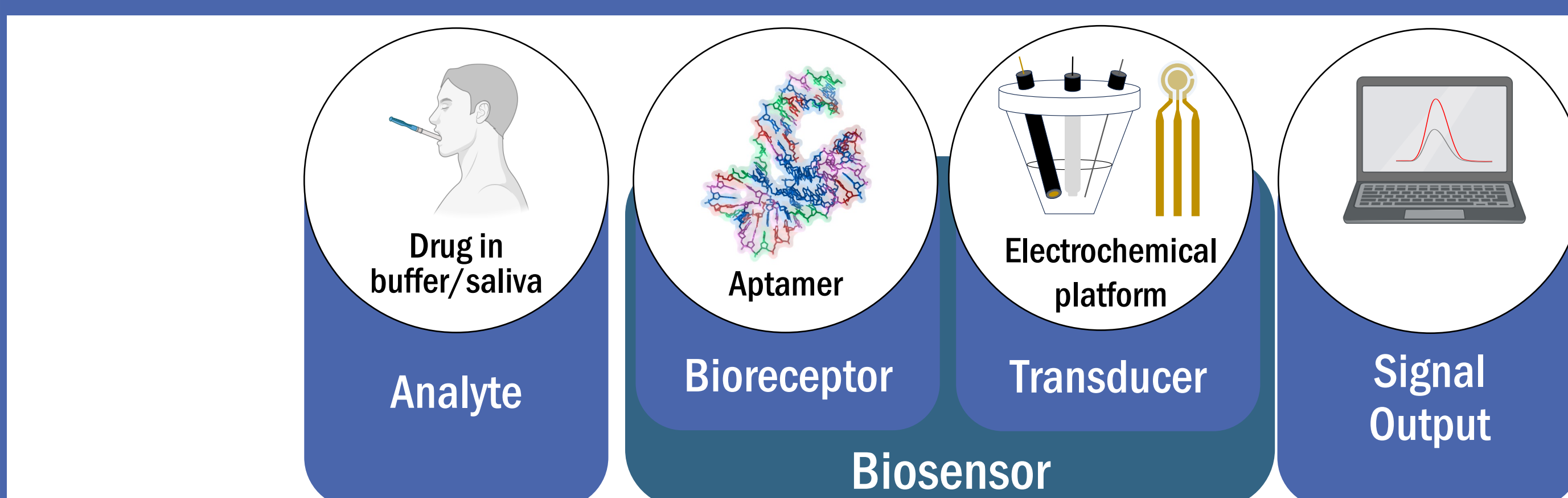
- "Aptasensors"**: biosensors based on aptamers are ideal for monitoring illicit drugs on the roadside.
- Aptamers** are single-stranded oligonucleotides that fold into defined architectures by binding specific targets with **high affinity** and **selectivity**.

Advantages over classical antibodies

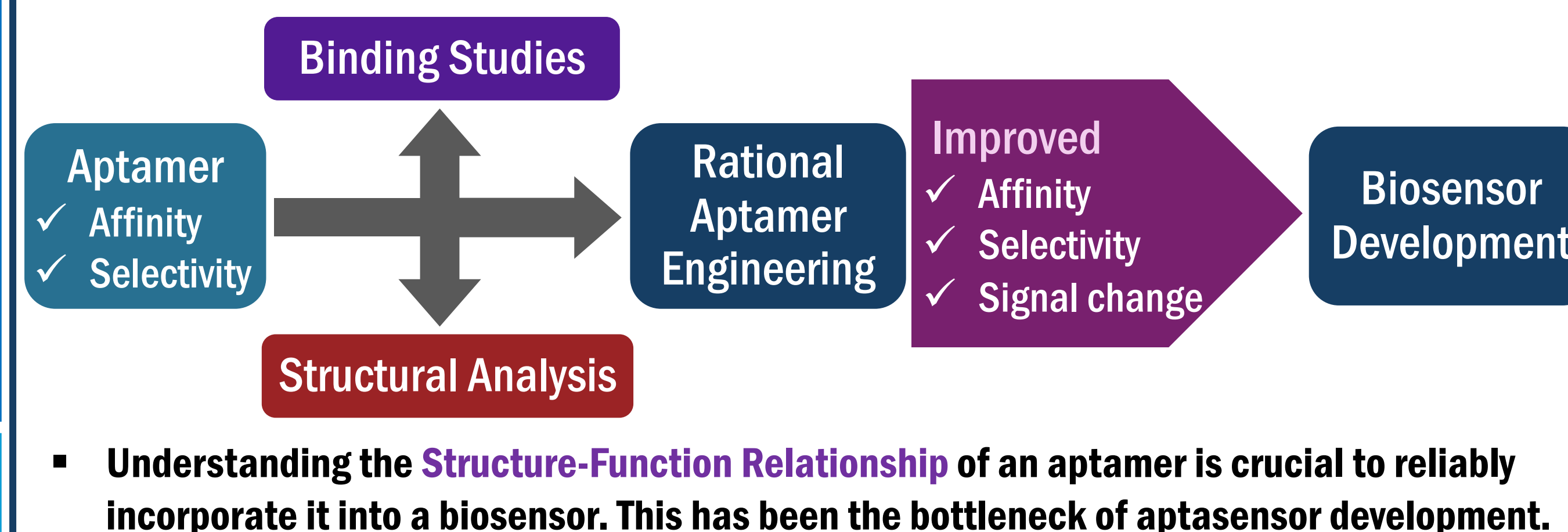
- ✓ Stability
- ✓ Ease, consistency and scalability of synthesis
- ✓ Low immunogenicity
- ✓ Lower cost
- ✓ Ability to chemically modify and engineer easily



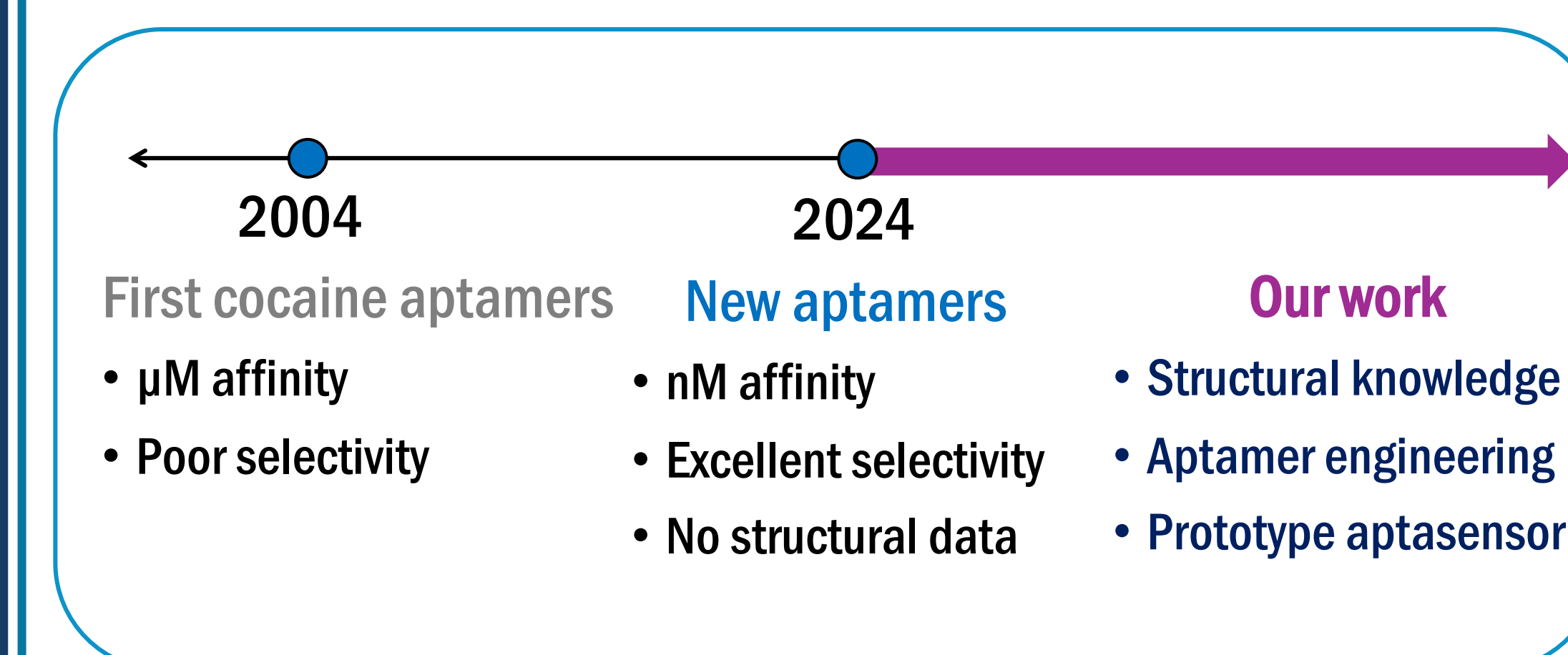
3 E-Aptasensing Platform



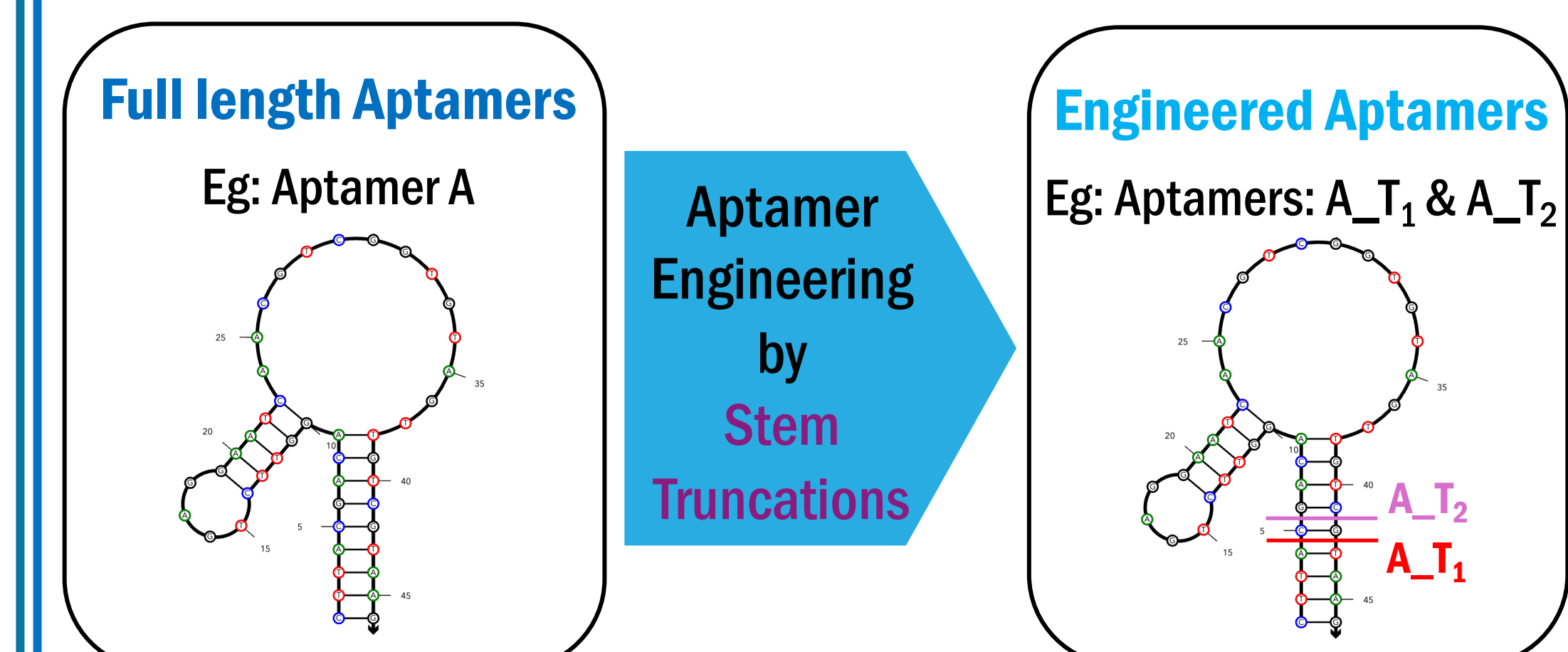
4 Biosensor Development Workflow



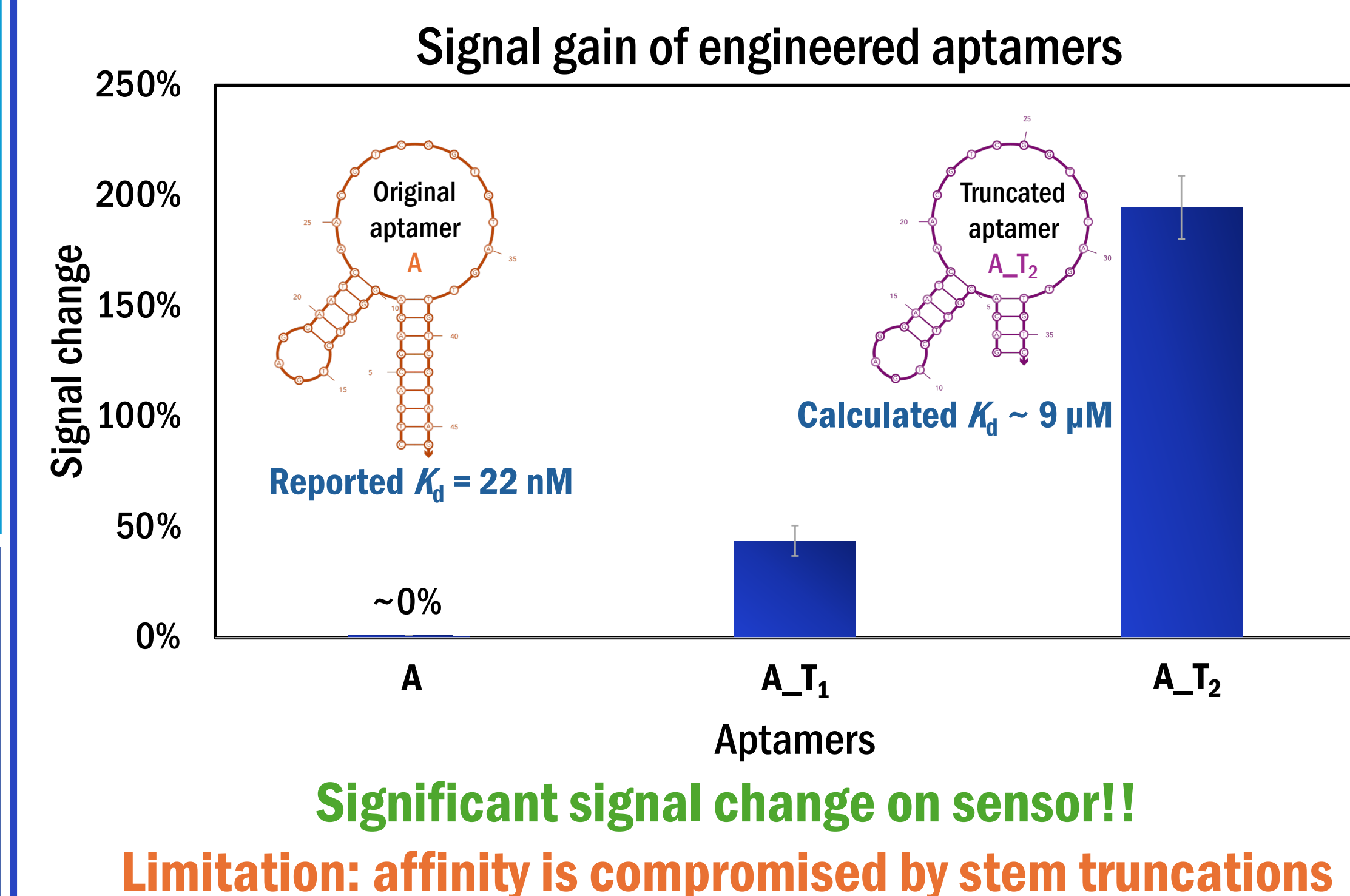
5 Literature & Novelty



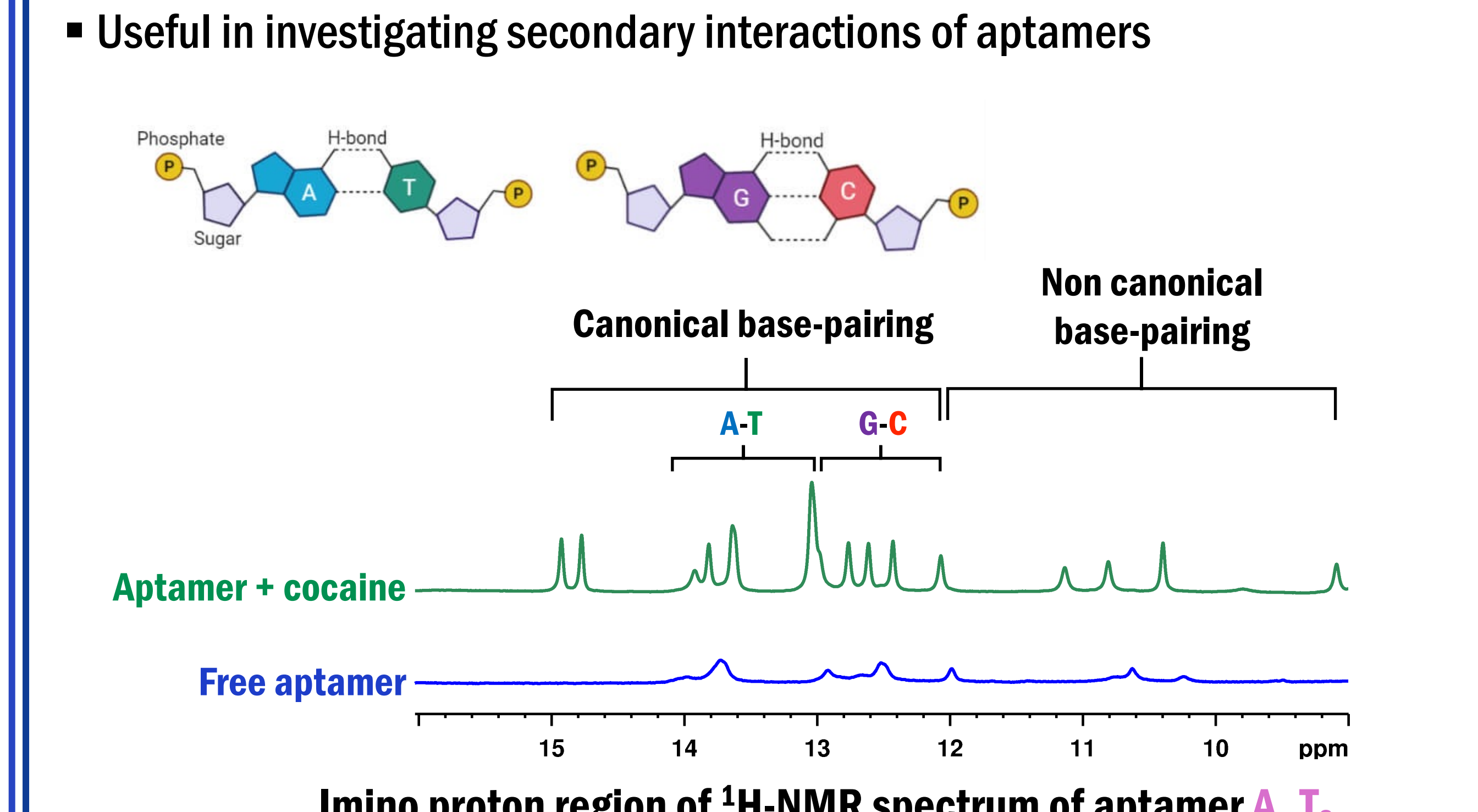
6 Initial Aptamer Design



7 Results on E-aptasensor



8 Nuclear Magnetic Resonance (NMR) Spectroscopy



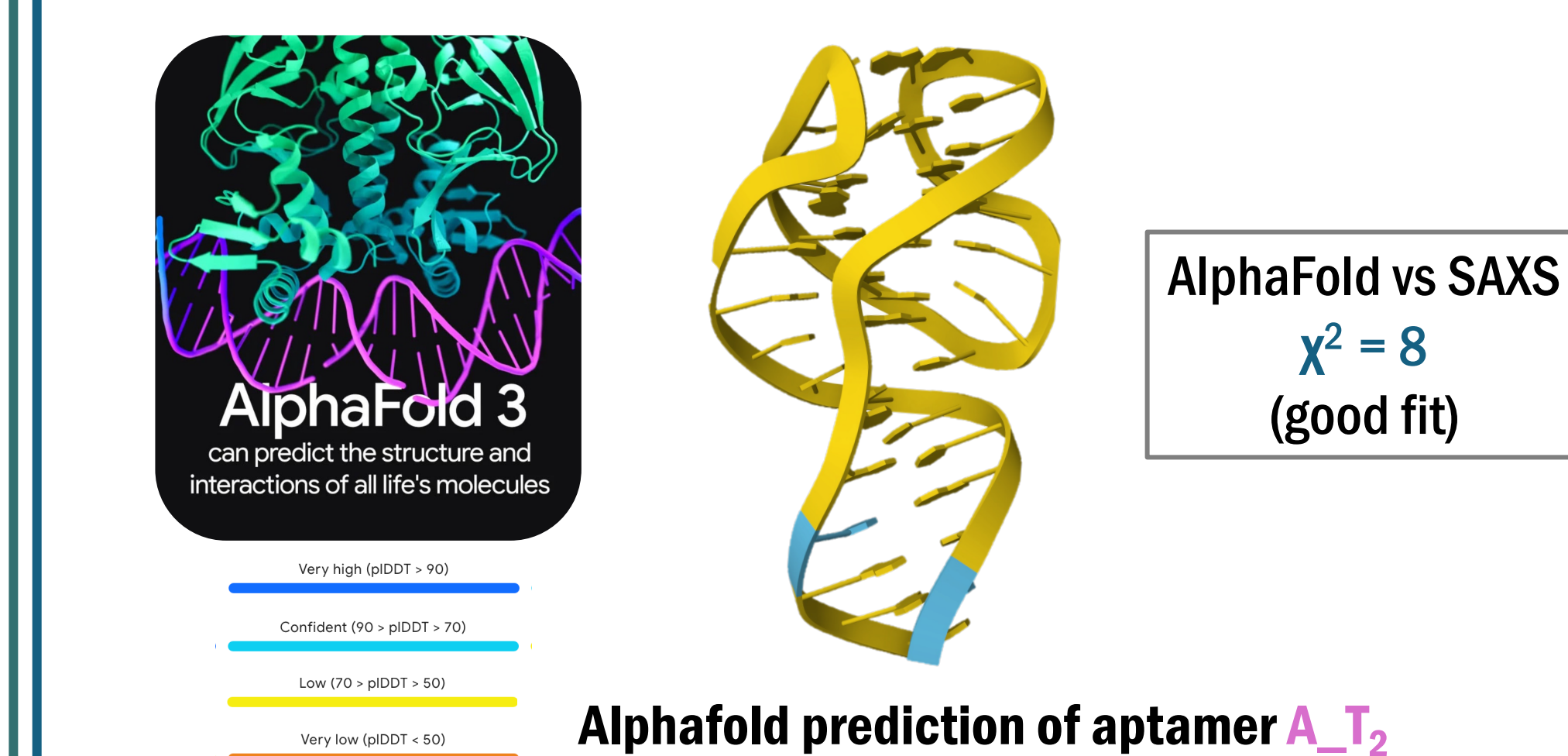
9 Small-angle X-ray Scattering (SAXS)

- Provide low-resolution structural information of aptamers in solution

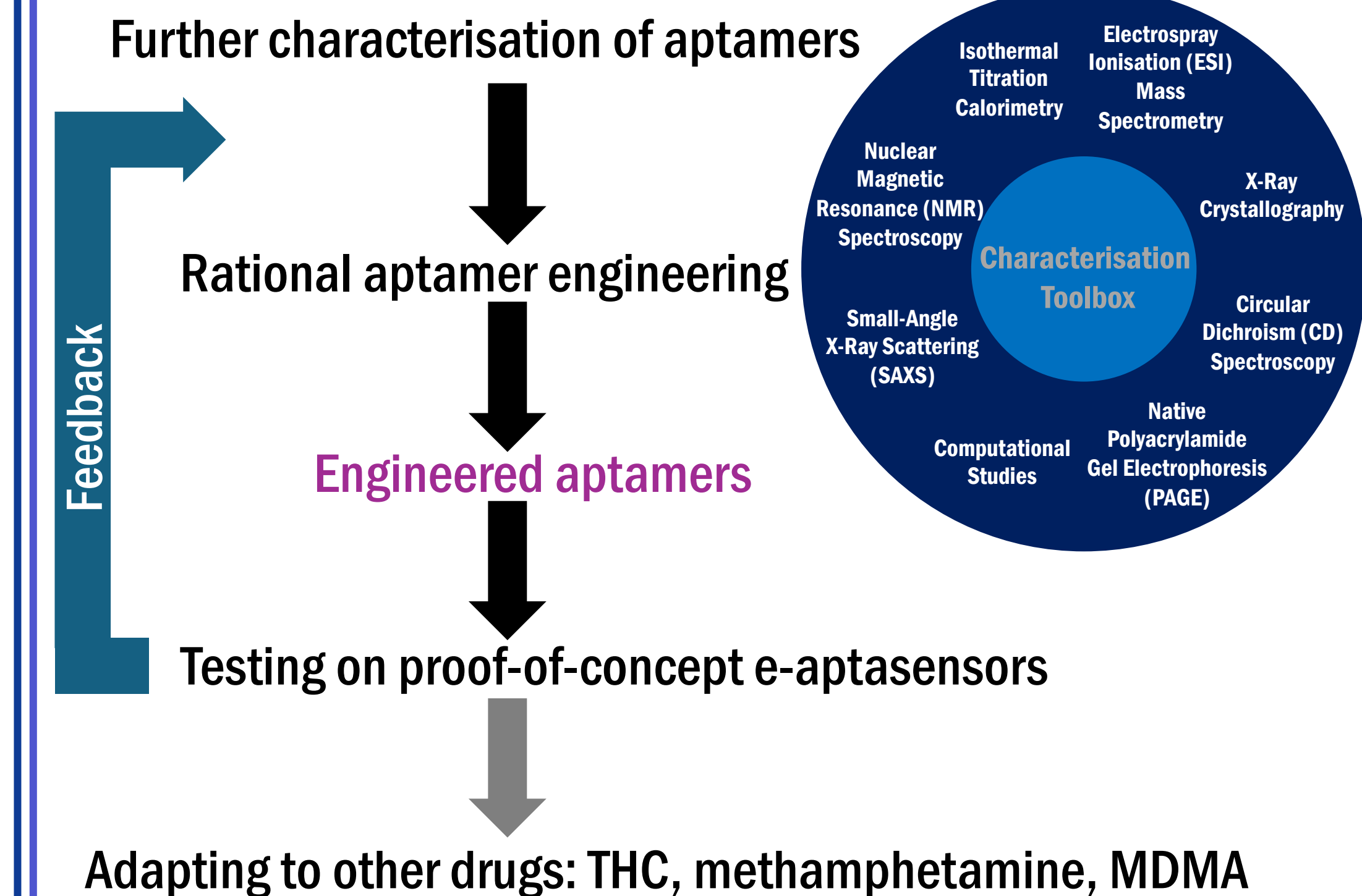
Structural parameters	Free aptamer A_T2	Aptamer A_T2 + cocaine
Overall shape	Partially folded/elongated/ flexible	Fully folded/ compact/ rigid
Radius of gyration (R_g)	20.29 Å	15.60 Å
Maximum dimension (D_{max})	75 Å	49 Å
Structure envelope prediction (by Dummy Atom Modelling)		

Structural characterisation provides strong evidences of "structure switching" of the aptamer upon cocaine binding

10 Computational Predictions



11 Future Work



➤ This work is launch-point towards developing a functional, portable biosensing device suitable for routine roadside drug testing in oral fluid, meeting legislative requirements.

SUSTAINABLE DEVELOPMENT GOALS

3 GOOD HEALTH AND WELL-BEING
Target 3.5: Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse
Target 3.6: Halve the number of global deaths and injuries from road traffic accidents by 2030

References

- Hasan, R., et al., A systematic review of factors associated with illegal drug driving. Accident Analysis & Prevention, 2022. 168: 106574.
Alkhamis, O., et al., High-Affinity Aptamers for In Vitro and In Vivo Cocaine Sensing. Journal of the American Chemical Society, 2024. 146(5): 3230-3240.