The Researcher's Guide to Measuring Binding Affinity and Why It Matters

NANOTEMPER

About this eBook

Find out the key principles for measuring binding affinity, including the critical parameters to consider and what solutions are available. Whether you're just starting to learn about binding interactions or you want a refresher, this guide will provide helpful tips to better understand, evaluate, and eventually purchase the best technology for your needs.

Contents

What is binding affinity?

While it's very common for biologists and chemists to test whether or not two molecules interact with each other, it's much more useful to gather information on the nature of that interaction. How strong is it? How long will it last? What does this mean for its biological function? These questions can be answered by studying binding affinity.

Binding affinity is the strength of the interaction between a single biomolecule and its binding partner, or ligand. It can be quantified, providing information on whether or not molecules are interacting as well as assigning a value to the affinity.

Typically, when measuring binding affinity, you're interested in several parameters, but mostly in the unit of measurement called the dissociation constant (K_d), which defines the likelihood that an interaction between two molecules will break. The smaller the dissociation constant, the more tightly bound the ligand is and the higher the affinity is between the two molecules.

> *"The dissociation constant (K_d) defines the likelihood that an interaction between two molecules will break and is a useful measurement to quantify binding affinity."*

Binding affinity is an important metric used in both academia and industry. Academic researchers study binding affinity to learn about structural biology, structure-function relationships, and the intermolecular interactions that drive biological processes. On the other hand, drug developers study binding affinity to identify high-affinity molecules that bind to drug targets selectively and specifically. In this case, affinity can guide decisions about the biological relevance of a particular molecule, such as whether the molecule under investigation warrants further screening or characterization.

Why measure
binding affinity?

Almost every process in biology can be attributed to an interaction between molecules. With the thousands of individual molecules that make up a cell, researchers are challenged with determining which types of molecules interact with each other and figuring out the consequences of these interactions.

Scientists use K_d to determine or “rank-order” binding reactions that may often translate into biological function or uncover the relevance of the targets being examined. The more researchers know about these interactions, the more they understand the biological systems in which they work with their intricate network of molecular pathways that control various cellular processes.

Precisely characterizing biomolecular interactions in a biological system is an important cornerstone in basic research. In applied science, measuring the binding affinity of interactions is a prerequisite for the development of new products, such as drugs, enzymes or biomarkers. Measuring binding affinity has many applications, including identifying and screening small and/or large molecules, monitoring the regulation of cellular pathways, screening compound and drug candidates, testing structure-function relationships, and optimizing the development of assays that examine the interaction of two molecules.

“Precisely characterizing biomolecular interactions in a biological system is an important cornerstone in basic research.”

When do researchers measure binding affinity?

Now that you understand the what and why of binding affinity, it’s time to discuss when it comes into play in the research workflow. Primarily, when you are interested in finding out if two molecules interact in a pathway or process of interest, you use binding affinity assays to see how they interact or bind to each other.

You can also measure binding affinity when modifying a molecule as a way to see how changing its binding properties relates to the pathway or process you are studying. Binding affinity is also useful when you need to develop a functional assay to monitor a pathway, as you may need to measure binding as part of the assay.

Academic researchers typically want to understand the biology and regulation of a target molecule that may or may not have any therapeutic potential. For example, to understand a molecular pathway, it is important to be able to selectively modify molecules and quantitatively determine how these modifications influence the overall pathway.

MEASURING BINDING AFFINITY IS USEFUL FOR:

- Characterizing receptor binding properties
- Measuring interactions with antibodies
- Analyzing protein complexes
- Investigating enzyme inhibition
- Observing molecular transport processes
- Mapping epitopes
- Optimizing leads
- Pursuing fragment-based lead discovery
- Measuring the effects of buffers, solutions, and concentration on binding affinity

On the industry side of the research spectrum, binding affinity is a useful metric during the earliest parts of the drug development process when scientists are screening for any compounds that interact with their target of interest. Beginning with a large library of compounds or ligands, industry scientists begin the screening process by identifying which ones bind to the target protein, and then continue with an increasingly smaller pool of compound candidates. After they complete much of their pre-clinical work, researchers may measure binding affinity to determine and rank various compounds' binding affinities for the target protein as an indicator of potency of a possible drug candidate.

What tools are available
to measure binding affinity?

Scientists use many different tools to measure binding affinity, although most of them fall into one of two categories: qualitative methods and quantitative methods. Qualitative methods such as ELISAs, pull-down assays, and gel shift assays work by immobilizing one protein to a substrate and applying another protein (typically containing a label or reporter tag) to it. If the two proteins bind, they release a detectable signal. These methods merely provide a yes/no answer as to whether binding occurred. These techniques may be suitable for labs that occasionally analyze protein interactions or are examining protein interactions at a very gross level.

QUALITY COUNTS

When it comes to measuring binding affinity, or performing any other experiment, for that matter, the quality of your results will depend on the quality of the source material. If you don't have any data on the quality of your source material, the experiment is less likely to succeed.

In contrast, quantitative methods provide a scalar readout of binding affinity, releasing a signal that indicates the strength of the interaction. Biosensor-based methodologies work by immobilizing a binding partner to a surface and presenting the test partner to interact with it. The change in signal is observed and recorded by the instrument. Other quantitative methods use capillaries or tubes instead of immobilizing proteins to a surface.

In this section, we'll walk through the most common biophysical technologies and their strengths and weaknesses in terms of throughput, speed, sensitivity, and ease of use.

Surface Plasmon Resonance

Surface plasmon resonance (SPR) is a common biosensor-based technique for measuring biomolecular interactions.

How it works

SPR is a surface-based biosensor reporting technology. It requires the immobilization of one binding partner, the ligand. The other binding partner, the analyte, is injected into a flow cell and comes into contact with the ligand on the surface at a constant flow rate. The interaction of ligand and analyte leads to an increase in mass bound to the surface, which results in a signal change. The signal is plotted in resonance units (RU) (also referred to as response units). The resulting sensograms display an association phase which depends on the association rate constant (k_{on}), followed by a dissociation phase (only buffer is pumped through the flow cell) which depends on the dissociation rate constant (k_{off}). By testing different analyte concentrations presented to a constant amount of immobilized ligand, the k_{on}, k_{off} and K_d of the interaction can be determined.

Strengths

SPR determines binding kinetics and constants using label-free detection, which eliminates the need for dyes and tags and allows for higher-sensitivity measurements. This method also conserves lab resources by consuming low volumes of sample.

Weaknesses

Immobilization of the ligand is not always straightforward. Although diverse chip-surfaces, coupling chemistries and even specific chips are available, some ligands cannot be immobilized in a functional way. This is especially important in small molecule research, where capture antibodies cannot be used (to avoid unspecific binding to the antibody). Many “difficult” targets, such as membrane proteins, are fragile and do not tolerate the acidic surface of the SPR assay.

Also, for interactions where the analyte does not wash off easily, scientists must identify regeneration conditions that can break the ligand-analyte interaction to facilitate dissociation but leave the ligand intact for another binding experiment.

Additionally, SPR measures changes in refractive index. Any buffer component that influences the refractive index of a sample (e.g. DMSO, a common solvent for small molecules) can cause artifacts in SPR measurements. Usually, control experiments are necessary when working with DMSO. Finally, because SPR depends on mass changes on the chip surface, this technology is not an optimal solution for small molecule research.

Conclusion

SPR is a highly sensitive and precise tool that provides kinetic and affinity data. Considered a gold standard for both academic and industry research applications, it has many established standard protocols. However, it can be costly and a bit complicated to operate, and is not suited as a walk-up instrument in a dynamic research setting.

Isothermal Titration Calorimetry

Isothermal titration calorimetry (ITC) is considered the most quantitative technique available for measuring the thermodynamic properties of interactions.

How it works

ITC is a calorimetric method which measures binding-induced heat changes. For this, a sample in-solution is placed into a sample cell, and water is placed into a reference cell. Both cells are kept at exactly the same temperature. Then, titrating amounts of the binding partner are added into the sample cell while stirring. The energy required to keep the cells at identical temperatures is measured, meaning that the heat released or absorbed due to a binding event results in a measurable signal. This signal becomes smaller with increasing occupancy of the target molecule. From the data, one can calculate K_d, stoichiometry, and binding thermodynamics (ΔH, ΔS).

Strengths

This technique relies upon the accurate measurement of heat changes that result from the interaction of molecules in solution. There is no need to label or immobilize either binding partner as the absorption or production of heat is an intrinsic property of virtually all biochemical reactions. In addition, ITC can be used to measure affinity and stoichiometry, and is the only technique in this list to enable direct determination of thermodynamics (ΔH, ΔS).

Weaknesses

ITC requires large quantities of sample. Any miniaturization of the instrument would require a massive improvement in sensitivity, which is technically challenging since the heat changes are so small. Also, since one always works at concentrations above the K_d, the amount of target in the sample cell has to be quite high. In addition, the concentration of the ligand in the syringe used to introduce one of the binding partners must be extremely high, especially when investigating rather weak interactions (in the higher μM range). This is often difficult to achieve for many protein preparations, or simply may exceed the solubility of the ligand because the volume per injection is small (1-5 μL).

Moreover, the buffers in the sample cell and syringe have to be identical, which is typically achieved by dialysis overnight. Discrepancies between the buffers results in additional signals which preclude a precise analysis of the data.

Another constraint of ITC is the low throughput. One titration typically takes 30 to 60 minutes, so the throughput is limited to ~20 to 40 K_ds per day (with the automated version taking up to 24 hours).

Because no single-use consumables are used, the instrument needs trained personnel to take care of regular washing and maintenance of the sample cells and syringes. Replacement of broken components can be costly and time-consuming.

Conclusion

ITC is often considered the “gold standard” for label-free protein binding analysis. In contrast to SPR, it is truly label-free, since it does not require any modification of the interaction partners. However, it’s not suited for high-throughput screening because of the large amounts of sample required and long titration times.

BioLayer Interferometry

BioLayer Interferometry (BLI) is a label-free technology for measuring biomolecular interactions.

How it works

BLI is an optical biosensor-based technique that analyzes the interference pattern of white light reflected from two surfaces: a layer of immobilized protein on the biosensor tip, and an internal reference layer. Any change in the number of molecules bound to the biosensor tip causes a shift in the interference pattern that can be measured in real-time, providing detailed information regarding the kinetics of association and dissociation of the two molecules as well as the affinity constant for the interaction (k_{on}, k_{off} and K_d). Due to the biosensor tip design, the technique is highly amenable to both purified and crude samples as well as high throughput screening experiments. The detection method can also be used to determine the molar concentration of analytes.

Strengths

Its ease of use and throughput make it an attractive option, especially for labs developing mAb. Kinetic analysis (k_{on}, k_{off}) and analysis of affinity can also be performed. Measurements are fast as it is a "dip and read" methodology.

Weaknesses

BLI is a less sensitive and less robust method than SPR, which makes it poorly suited for applications examining small-molecule interaction partners. This, however, does not apply for most mAb applications.

As with SPR, a covalent coupling of biomolecules is difficult and faces the same hurdles in terms of immobilization conditions. Moreover, it is hardly possible to achieve identical ligand coatings of multiple biosensor tips, so that regeneration of a tip is still required if concentration series are measured.

Especially for high-affinity interactions, the mass-transfer-limitation is an important factor, as well as the limitation in measurement times due to sample evaporation from the plate.

Conclusion

Although BLI is less sensitive than SPR, it's easier to use. It's a great tool for mAb development workflows. There are options for low, medium and higher throughput sample analysis.

MicroScale Thermophoresis

MicroScale thermophoresis (MST) quantitatively examines molecular interactions in solution at the microliter scale. It measures binding interactions utilizing the characteristics of thermophoresis combined with Temperature Related Intensity Change (TRIC). Thermophoresis is the movement of molecules in the presence of a thermal gradient and TRIC is the quenching of a fluorophore when subjected to a thermal gradient. Thus, MST is influenced by a molecule's size, charge, hydration shell and the effects of TRIC. Altogether, the data generated results in a precise and robust measurement of binding interactions and modifications. The method works equally well in standard buffers and biological liquids like blood or cell-lysate. MST provides information regarding the binding affinity (K_d) of two or more interacting proteins.

How it works

MST is performed in-solution in thin, glass capillaries that hold low, microliter volumes of sample. The method is immobilization-free, and analysis can be done in any buffer including complex bioliquids, thus examination occurs in close-to-native conditions. The strength of the interactions between a fluorescently labeled sample (or intrisically fluorescent sample) and a binding partner (or ligand) are measured while a microscopic temperature gradient, induced by an infrared laser, is applied over time. The resulting MST signal is detected and plotted against the ligand concentration to obtain a dose-response curve, from which the binding affinity (K_d) is automatically calculated.

Strengths

It is an in-solution method in which binding partners being studied are not immobilized on a biosensor or solid surface. With this technology, binding affinity is determined using very small amounts of sample. Results are measured in minutes. It's also very flexible, meaning you can look at molecules of all weights and in all sorts of buffers — ideal for investigating sensitive molecules that need specific buffer conditions, or for looking at interactions in close-to-native conditions. A label-free option is available. Because there are minimal moving parts and nothing needs to be cleaned, MST can be considered a maintenance-free instrument.

Weaknesses

Absolute binding kinetic constants (K_{off} and K_{on}) can not be identified with MST. While there are label-free options, fluorescent labeling of one of the binding partners is typically required to perform an analysis.

Conclusion

MST is the most versatile, rapid and easy-to-use method and can precisely measure binding affinity for virtually every type of biomolecular interaction. It has been shown to obtain results on difficult targets that are challenging to evaluate by other binding affinity methods.

Technologies for measuring binding affinity

	Surface Plasmon Resonance (SPR)	Isothermal Titration Calorimetry (ITC)	BioLayer Interferometry (BLI)	MicroScale Thermophoresis (MST)
Requires high amount of sample	No	Yes	No	No
Label-free	Yes	Yes	Yes	Optional
Immobilization-free	No	Yes	No	Yes
High throughput	Yes	No	Yes	Yes
Easy to use	No	No	Yes	Yes
Instrument costs	High	Low	Medium	Medium
Consumable costs	High	Low	Medium	Medium
Measures binding kinetics	Yes	No	Yes	No

How do I evaluate my research needs?

If you've determined that you need an instrument that can measure binding affinity, there are some simple steps you can take to find out which one would be right for your lab. Sometimes, just the thought of purchasing new technology can be overwhelming—it can be a costly and significant decision for your lab. But you can make the process much easier for yourself by taking the time to think about your needs and how the instrument could fit into your established workflow. What are your research or project goals? What is most important to you? What are your biggest challenges and bottlenecks in your workflow? Setting costs and budgets aside for a moment, think about what you need in terms of throughput, speed, sensitivity, robustness and precision of data.

Be sure to not only think about the immediate needs of your lab, but also consider what you plan to work on in the foreseeable future. For example, today, you may be interested in protein-DNA interactions, but in a few months, your research may expand to include G-protein-coupled-receptors. Your work is most important and may require flexible technology that can support it for years to come. When you are evaluating a platform for its flexibility, ask the vendor if the platform's hardware and software can be upgraded. This way, you will get the most from your system today and in the years to come.

Additionally, you may want to choose an instrument you will use frequently because it makes your workflow more efficient, thereby saving you a lot of time and money. Finally, consider the ease-of-use of the technology, since instruments that are too complicated to use are often abandoned by the laboratory staff once the expert user leaves.

> *"Choose an instrument you will use frequently because it makes your workflow more efficient, thereby saving you a lot of time and money."*

HOW CAN I FIND THE RIGHT SOLUTION?

Once you have a better idea of what you need, it's time to start searching for information about the various solutions available. In addition to reading through this guide, there are many ways to do your due diligence so you can make as educated a decision as possible.

TO LEARN ABOUT TECHNOLOGIES THAT MEASURE BINDING AFFINITY, YOU CAN:

- Visit scientific websites
- Visit vendor websites
- Visit online blogs and forums
- Ask colleagues
- Visit vendor booths at conferences
- Attend a webinar
- Call sales representatives
- Look at advertisements and articles in journals (online and print)
- Listen to the chatter on social media channels
- Explore scientific groups

VENDORS (ALPHA ORDER)

ForteBio
www.fortebio.com
ForteBio makes Octet and BLItz, instruments for BioLayer Interferometry

GE Healthcare Life Sciences
www.proteins.gelifesciences.com
The Biacore Series from GE uses Surface Plasmon Resonance

Malvern Instruments
www.malverninstruments.com
Malvern's MicroCal instruments enable Isothermal Titration Calorimetry

NanoTemper Technologies
www.nanotempertech.com
NanoTemper offers Monolith, a series of products for MicroScale Thermophoresis

Analyzing binding affinity can get complicated, you may even need to consider adopting multiple technologies to tackle your research. You could, for example, use a faster technology that requires less sample to filter out 80% of the molecules in your sample, and then use a slow, more complex method to further study the remaining 20%.

The approach of using a faster, less complicated technology will save you time, effort and money and allow you to focus on the most relevant targets that will further your research.

How do I evaluate vendors?

Several vendors offer technologies for measuring binding affinity, and you can find most of the information about their product offerings on their websites or in sales collateral such as catalogs, brochures, and videos.

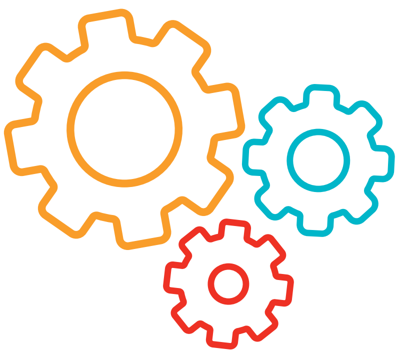
You can help yourself answer fundamental questions about the features of the platform you are considering by browsing the product specifications and features, such as whether or not the instrument and software are user-friendly, the size of the system's footprint, and what consumables are required for its use.

Although this information will certainly help, it may not answer all of your questions. Therefore, you may need to contact the vendor. Before you do that, you may want to prepare a list of questions that will help you determine if the solution is right for your lab. These might include: Are the consumables complicated to use? How easy is it to collect data? Does the platform require training to operate? What types of upgrades are available? Does it have the throughput I need?

Remember, you're looking for solutions that solve problems tied directly to your research goals. A lot of technologies boast cutting-edge features that sound impressive but are not practical for everyday use. Instead of letting those extra bells and whistles influence your decision, stay focused on only the attributes that matter to your research.

For a third-party perspective, you could ask colleagues in the research community what instruments they use. Scan through peer-reviewed research that used the technology and determine if the platform can address your research challenges. You could also read reviews online to see what is recommended. At this stage, it's important to gather as much information as possible about each technology's benefits and drawbacks.

Pro Tip



When you purchase a piece of equipment, you are starting an ongoing relationship with a vendor. When purchasing a platform, scientists often overlook the step of vetting the vendor's reputation and credibility in the industry. Questions to ask include: How long has the company been around? How many customers do they have? Are they global? Am I served by a local representative? What kind of support do they offer, and are customers satisfied with the support they receive? In other words, will this company be with me when I run into problems? What's their response time, and how active will they be in solving my problem?

The most reliable source for this type of information comes from 1) talking with colleagues who have experience with that vendor, and 2) reading product reviews generated by customers. Tap into your network to learn about a company's reputation.

This information will help you decide which vendor offers the best solution for your lab.

How do I make an informed decision?

Based on the information you find by researching potential solutions and their manufacturers, you should be able to narrow down your list to one or two choices. You may want to ask vendors for a product demo so you can see how their systems work on your samples. In fact, their response can be a good indication of how easy their product is to set up and run. If the demo can be done quickly and without much difficulty, you can imagine how easy it will be to integrate it into your workflow.

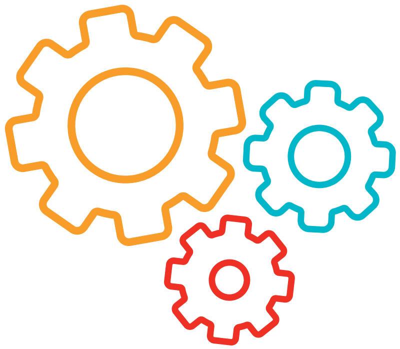
Use the demo as an opportunity to put these products to the test. Don't just test them yourself — let the other researchers in your lab run samples on the system and provide feedback. Then, you will have a few more data points to further support your decision.

"You may want to ask vendors for a product demo so you can see how their systems work on your samples. In fact, their response can be a good indication of how easy their product is to set up and run."

How do I acquire the technology?

Once you have made a final selection, you are ready to begin the process of acquiring a new technology. You can embark on this endeavor by yourself, or you can work with a contract research organization, a collaborator, a vendor, or through a core facility to incorporate the technology into your workflow.

Pro Tip



Buying a new instrument is not often a decision you make alone. There is usually a committee or group in place who must weigh in. An essential part of the buying process is figuring out who the stakeholders are and what they need to know so you can supply them with the right information.

In most cases, a lab manager or procurement officer is responsible for the budget. He or she will likely want to know that you've evaluated your options and that you are choosing the best instrument for the job. Engage these decision-makers early and often. You will end up presenting them with multiple quotes and options before all is said and done, so it's good to get their input before expecting to receive their full buy-in.

Also influencing the decision is anyone who will be using the instrument. Generally, your colleagues' top concerns will include making sure the software and instrument are easy to use, that it doesn't slow down their work, and that it is easy to train others to use it. These influencers may also want to evaluate the instrument's technical capabilities to make sure it can give them the data they want.

If you are the person taking the lead on purchasing the equipment for your lab, the first question to ask is: How much it will cost? Some offerings include the product only, but others may include the product as well as the software, and in some cases, they'll include consumables, too. To get a sense of the total cost of investment, including upfront and ongoing costs, ask vendors what is included and not included in the quote they give you.

Next, you will need to figure out a way to pay for it. Your institution may already have a plan in place for purchasing new capital equipment, in which case you may be able to use money that has been set aside previously. Alternatively, you can factor in your new equipment purchase as part of a new budget for the following year. Depending on how the purchasing process works at your organization, you may need to involve a lab manager or procurement officer. Find out what kind of documentation you need to provide to gain approval.

Your funding source for new equipment will vary depending on if you are in academia or industry. At a university, you can apply for a grant to fund the purchase. Also, you may receive support from external sources that are interested in funding your research. These external sources include foundations, private donations, crowdsourcing platforms such as GoFundMe, or collaborations with other groups that have similar interests.

To make the purchase more affordable, consider asking for support from other groups at your institution who share your interests and have extra funding. Or, consider purchasing an entry-level instrument and plan to upgrade it at a later time.

As with any other big purchases, once the financing is in place, the rest of the process is relatively straightforward. Most technologies will require some form of installation, implementation, and training. Aside from occasional support and maintenance, your new instrument is ready to become an invaluable part of your workflow, providing valuable data that supports your research.

TOTAL COST OF INVESTMENT

Budgeting properly for a new instrument means looking at more than just the price tag––there are other costs to consider. Here is everything to be aware of when thinking about the total cost of your investment:

- **Purchasing costs** – the sticker price of the new system
- **Installation costs** – how much it costs to have the instrument set up by the vendor
- **Running costs** – how much it costs to run the system in terms of consumables and energy
- **Service and maintenance costs** – how much you will get charged for repairs or regularly scheduled maintenance, and how that impacts lab downtime
- **Support costs** – how much it will cost to get technical support for the software or scientific support for your applications
- **Additional software upgrades** – what you can expect to pay for major software upgrades

Buyer's Checklist

Here are questions to ask as you're going through the buying process.

Step 1: Explore your research needs

- What challenge(s) am I facing?
- Is there a solution available?

Step 2: Explore available solutions

- Does the solution solve my challenge(s)?
  - What are the benefits of the solution? Does that fit what I need now, in the near future, later?
- What types of solutions are available?
  - Am I getting the instrument only, the instrument and software, or the instrument, software and consumables?
  - Is support included?
  - Is service included?
- What is important to consider when selecting a solution?
  - Is the instrument user-friendly?
  - Is the software user-friendly?
  - Are the consumables complicated to use?
  - How easy is it to collect data?
  - Does the instrument have a small footprint?
  - Does it require training to operate?
  - What types of upgrades are available?
  - Does it have the throughput I need?

Step 3: Evaluate vendors

- Look at their credibility in the research community
- Are there many publications that use this solution? How recent are they, and are they in relevant journals that promote high-quality research?
- Who or which labs have their instrument?
- What do felllow researchers recommend?
- How long has the company been around?
- How many customers do they have?
- Are they global?
- What kind of support do they offer?
- Am I served by a local representative?

Step 4: Make an informed decision

- Compare the different technologies side-by-side
- Narrow to a few choices
- Ask a sales rep questions
- Ask for a demo
- Verify the solution fits the need

Step 5: Purchase the technology

- How much will it cost?
- What's included in the cost?
- How am I going to pay for it?
- Who is responsible in the buying decision?
- Will others be using the technology?
- What information do they need to know?

Conclusion

As a researcher, chances are a critical piece of your experiments involves knowing how a protein interacts with other molecules. By measuring binding affinity, you can gain new insights into those interactions and what they mean. Now that you're informed about what binding affinity is and how it works, you will know how to identify, evaluate and purchase the appropriate tools or technologies for your lab.

Resources for Binding Affinity

If you are interested in learning more about binding affinity and other bioanalytical screening methods, visit these resources:

LinkedIn Groups

Analytical & Bioanalytical Chemistry (ABC)
https://www.linkedin.com/groups/1822503/profile

Bioanalytical Method Development
https://www.linkedin.com/groups/4229880/profile

Bioanalytical Solutions
https://www.linkedin.com/groups/2458704/profile

Clinical/Nonclinical Bioanalytical and PK Consultants
https://www.linkedin.com/groups/1334367/profile

NanoTemper Bioanalytics User Group
https://www.linkedin.com/groups/4482307

Community Forums and Focus Groups

American Association of Pharmaceutical Scientists
https://www.aaps.org/Bioanalytical/

Bioanalysis Zone
https://www.bioanalysis-zone.com/

Peer-Reviewed Journal Articles

"A Guide to Simple and Informative Binding Assays"
http://www.molbiolcell.org/content/21/23/4061.full

"On the Binding Affinity of Macromolecular Interactions: Daring to Ask Why Proteins Interact"
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3565702/

When proteins matter.

NanoTemper's mission is to enable researchers to do the best science of their lives

NanoTemper Technologies is deeply committed to the best customer experience. Central to this is a strong focus on enabling researchers to easily, efficiently, and accurately perform protein characterization. With a broad offering of systems, software and consumables for evaluating binding affinities, protein stability and protein quality, scientists in pharmaceutical, biotech or academic labs will find an optimized workflow, quality results and responsive customer support. Work with a deeply experienced and globally operating team, and realize the NanoTemper experience.