An Urgent Paradigm Shift: Untapped Molecular Insights Vital to Advancing Life Sciences, Biomedicine and Pharmacy

GALVESTON, TEXAS, USA, October 4, 2023 /EINPresswire.com/ -- Textbooks traditionally describe proteins as entities that fold into specific 3D shapes, akin to Lego blocks, that neatly fit with other biomolecules. This "key and lock" perspective, a cornerstone of molecular biology for two centuries, chiefly centers on interactions under 5 Å.

However, this portrayal of proteins, often termed the "workhorses of biology," is not exhaustive. Approximately half of all proteins possess flexible, unstructured segments known as intrinsically disordered regions (IDRs). Owing to their dynamic, “shape-shifting” characteristics, it was a prevailing thought that IDRs might not interface as accurately with other biomolecules compared to their folded counterparts. This led to a presumption that these flexible segments might not significantly influence protein function.

A recent study (Pati et al., A disordered region controls cBAF activity via condensation and partner recruitment. Cell 2023;186:1-20. doi: 10.1016/j.cell.2023.08.032) overturns this notion, spotlighting IDRs as central players. Their role in forming condensates, essential structures that gather proteins and biomolecules at distinct sites, broadens our grasp of cellular mechanisms.

Emphasizing the importance of long-range molecular interactions, which range from 5 Å to over 1000 Å, is essential in understanding cellular functions amidst a molecularly crowded cellular environment. These interactions are not merely supplementary; they are crucial. As recently confirmed experimentally, they enable precise recognition, targeting, and quietly regulate numerous cellular activities (Lechelon et al., Experimental evidence forlong-distance electrodynamic intermolecular forces. Sci. Adv. 2023;8:eabl5855). The conventional "key and lock" model, although foundational, captures merely a fragment of this molecular saga. To fully comprehend the nuances of biological mechanisms, it's vital to recognize the paramount role of long-range molecular interactions.

The electron-ion interaction potential (EIIP) (https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.29.105) is a pivotal descriptor for these long-range molecular properties. EIIP has opened avenues to explore biology at a subatomic scale, heralding the era of Electronic Biology (http://electronicbiology.org/). This breakthrough approach has catalyzed the design of innovative drugs and vaccines against chronic and infectious diseases. Notably, these treatments display minimal toxicity and

heightened resistance to mutations found in cancer cells and pathogens. Furthermore, the insights from EIIP have shaped the formulation of dietary supplements and nutritious diets that resonate with fundamental biological principles (https://f1000research.com/articles/6-13).

In summation, to genuinely advance our biological comprehension and instigate a transformative phase in therapeutic innovations, integrating the age-old "key and lock" model with a deep dive into long-range molecular dynamics is indispensable. It is not simply an enlargement of our current understanding; it's a vital evolutionary leap, compelling us to embrace a rejuvenated view of the molecular basis of life.

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