# BOOK CHAPTER:


**Nucleus**

**A Collection of Research-based Science Articles**

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## Harnessing Nature for "Fruitastic" Applications: An Introduction to Bio-Derived Nanofluidic Channels


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**Abstract**

Nanofluidics, the study of fluid and ion transport within channels of nanometer-scale dimensions, offers unique transport behaviors driven by surface charge effects, electric double layer formation, and nanoscale confinement. Bio-derived materials such as cellulose, silk, chitin, and marine biopolymers present inherently aligned nanochannel networks, hierarchical architectures, and abundant functional groups, making them highly effective for precise ion selectivity and conductivity. Their renewable nature, mechanical robustness, and tunable surface chemistry position them as sustainable alternatives to synthetic nanofluidic systems. This chapter examines the fundamental principles of nanofluidic transport, the structural integrity of bio-materials, and their application in ion conduction and osmotic energy conversion. By uniting the elegance of nature's designs with modern engineering, these systems pave the way for a greener, smarter, and more energy-efficient future



**Keywords:** Nanofluidic Phenomena, nanochannel, bio-meterials


### 1 Introduction to Nanofluidic Phenomena:

Water is one of the most essential substances on Earth, sustaining all known life forms. Many biological processes rely on the movement of water through highly specialized micro and nanoscale channels. Understanding how water behaves under such extreme spatial confinement is therefore critical not only for unravelling natural processes but also for developing next-generation integrated engineering devices. The study