New Perspectives in Science Education
International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION

EDNA: An Interactive Elastic DNA Model for STEM Education and Research

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EDNA: Teaching DNA Through Touch

- Interactive elastic DNA model
  - STEM education focus
  - NPSE 2025 – Florence

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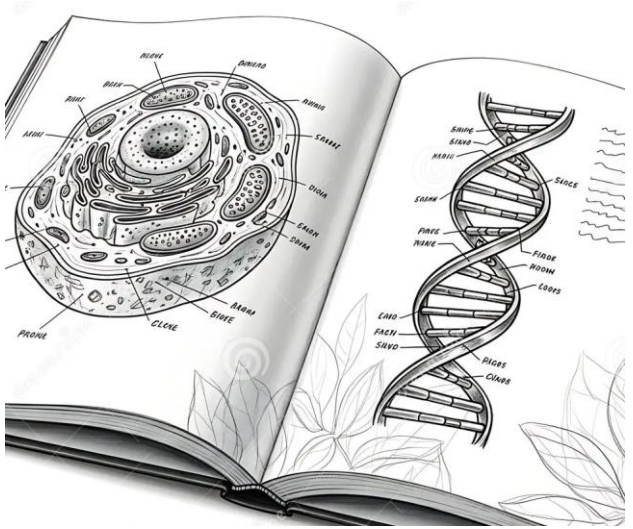
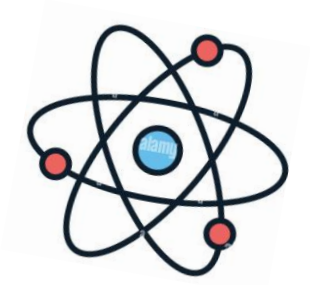
Why Rethink DNA Teaching?

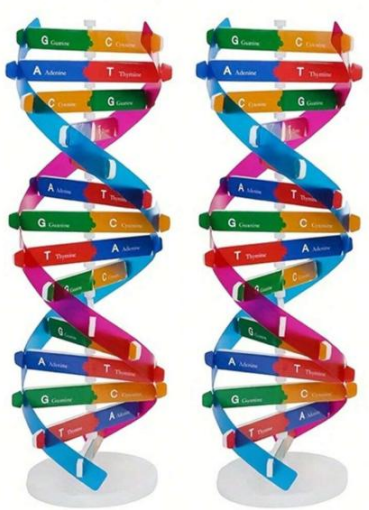
- DNA = iconic
  - Conceptually abstract
  - Often misrepresented

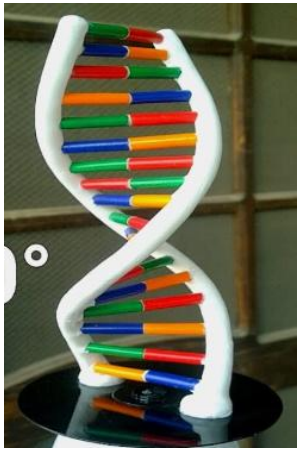




Common Misconceptions

- Left-handed helix
  - Flat ladder model
  - No groove distinction
  - Wrong hand
  - Too many basepairs



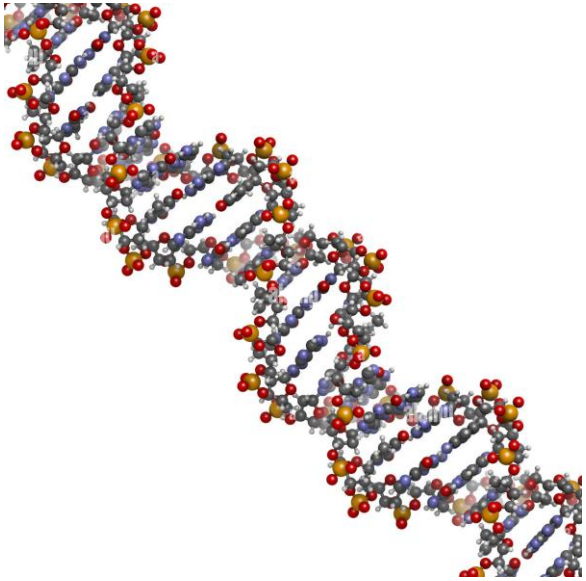


Educational Challenge

- 3D understanding
  - Mechanics intuition
  - Interdisciplinary links

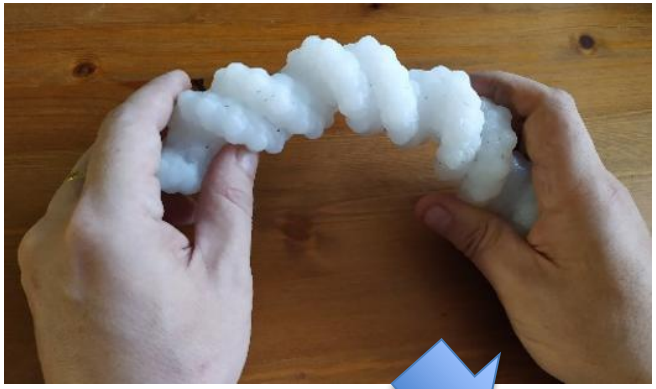
Learning Objective

- See structure
  - Feel mechanics
  - Connect to biology



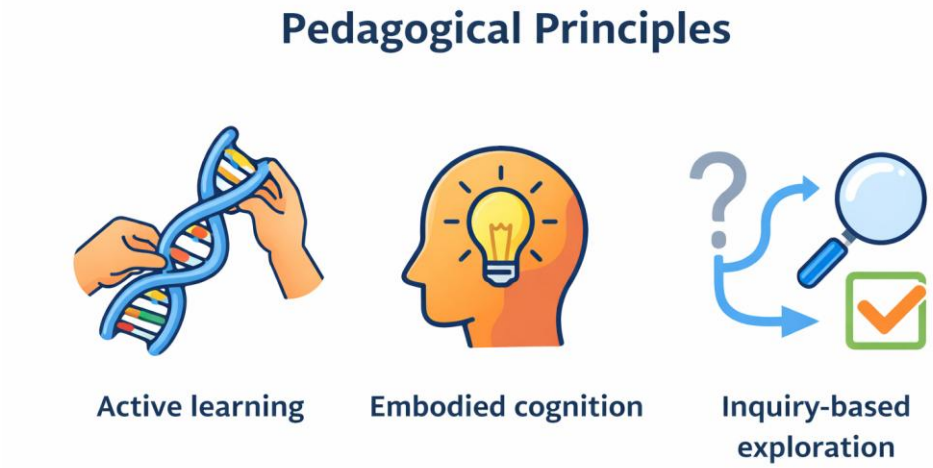
What is EDNA?

- Right-handed
  - Elastic
  - Scalable
  - Reusable



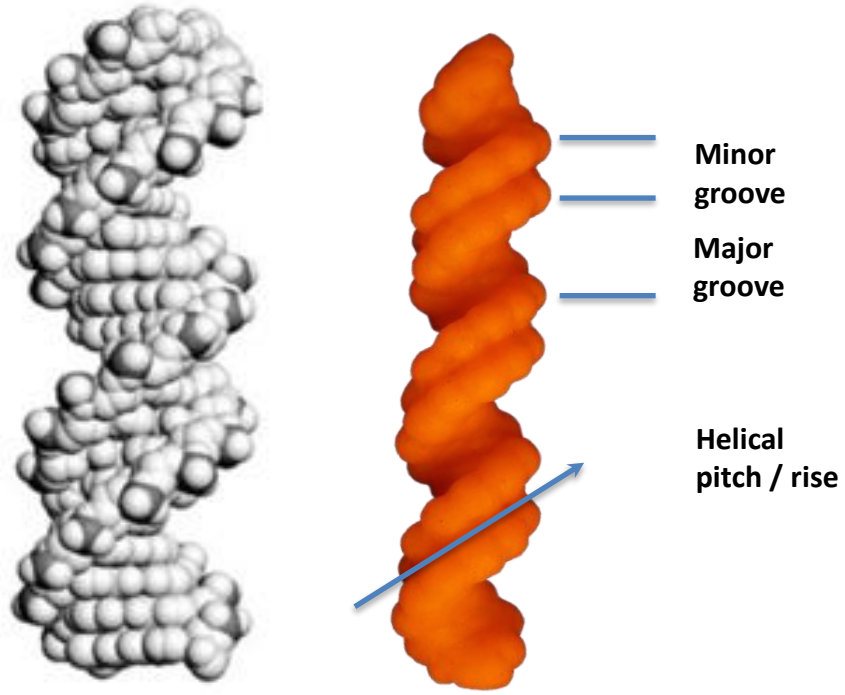
Pedagogical Principles

- Active learning
  - Embodied cognition
  - Inquiry-based exploration



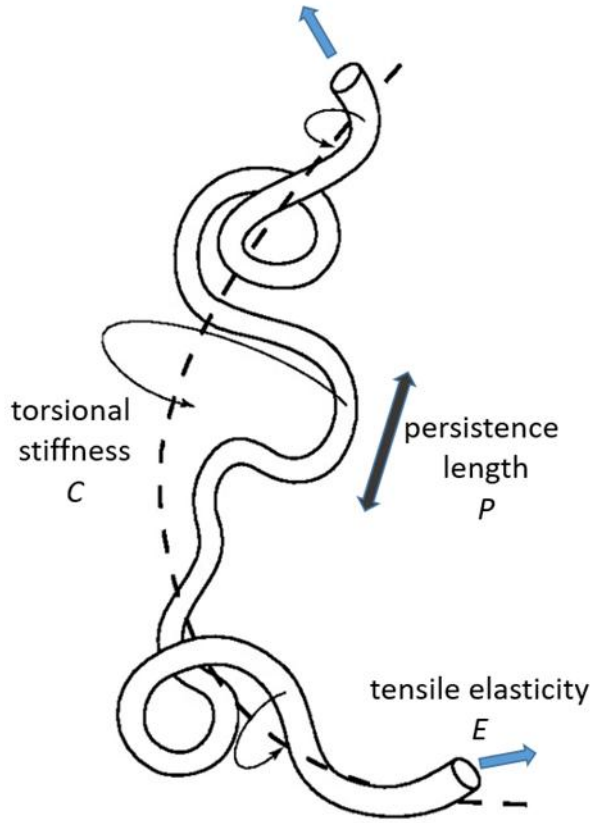
Core Structural Features

- 10 bp per turn
  - Major & minor grooves
  - Correct helical pitch



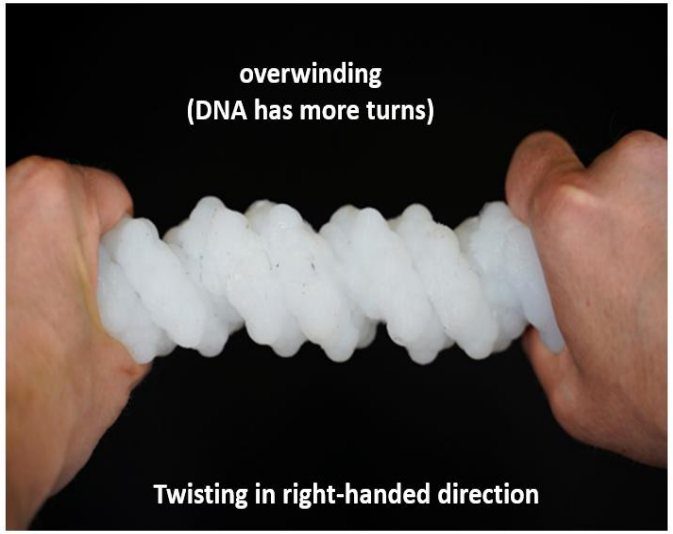
Mechanical Properties in Class

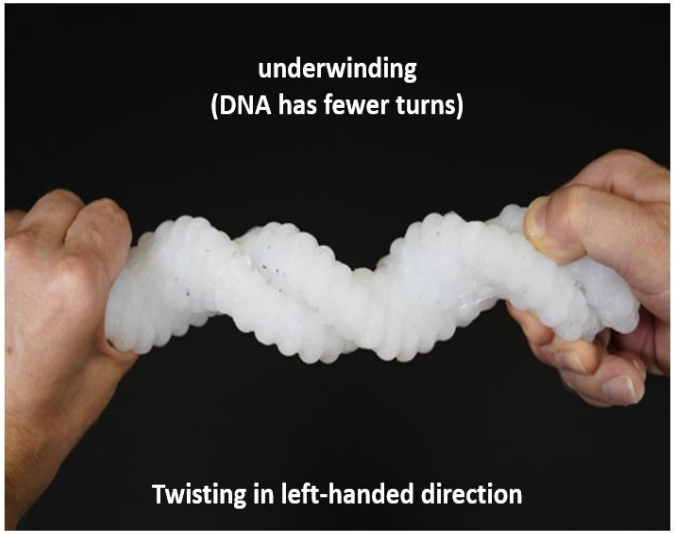
- Bending stiffness
  - Torsional stiffness
  - Elastic response



Classroom Demo 1: Twisting

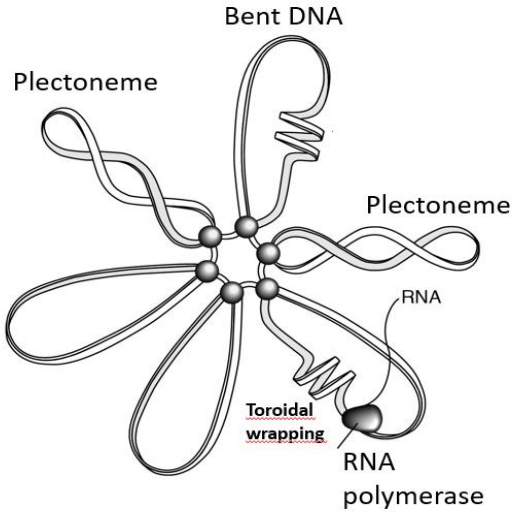
- Overwind
  - Underwind
  - Groove changes

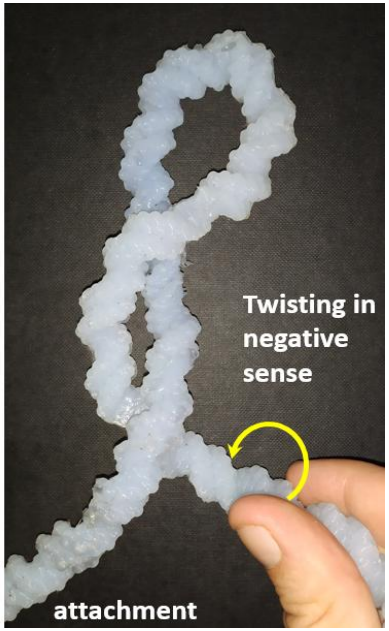




Classroom Demo 2: Supercoiling

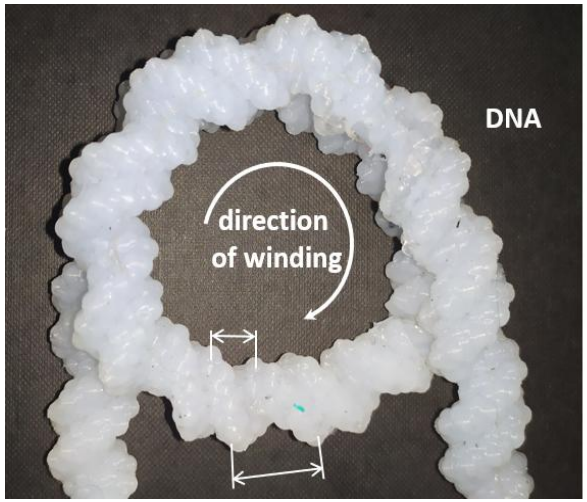
- Twist → writhe
  - Plectoneme formation

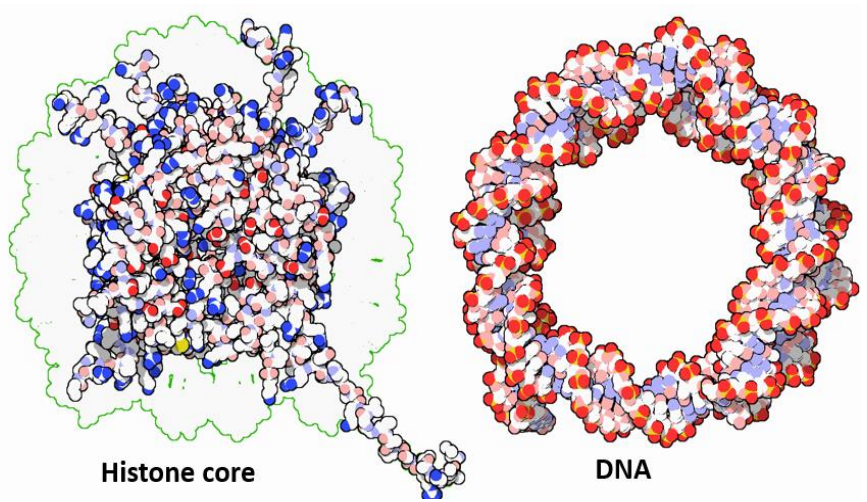




Classroom Demo 3: Nucleosome

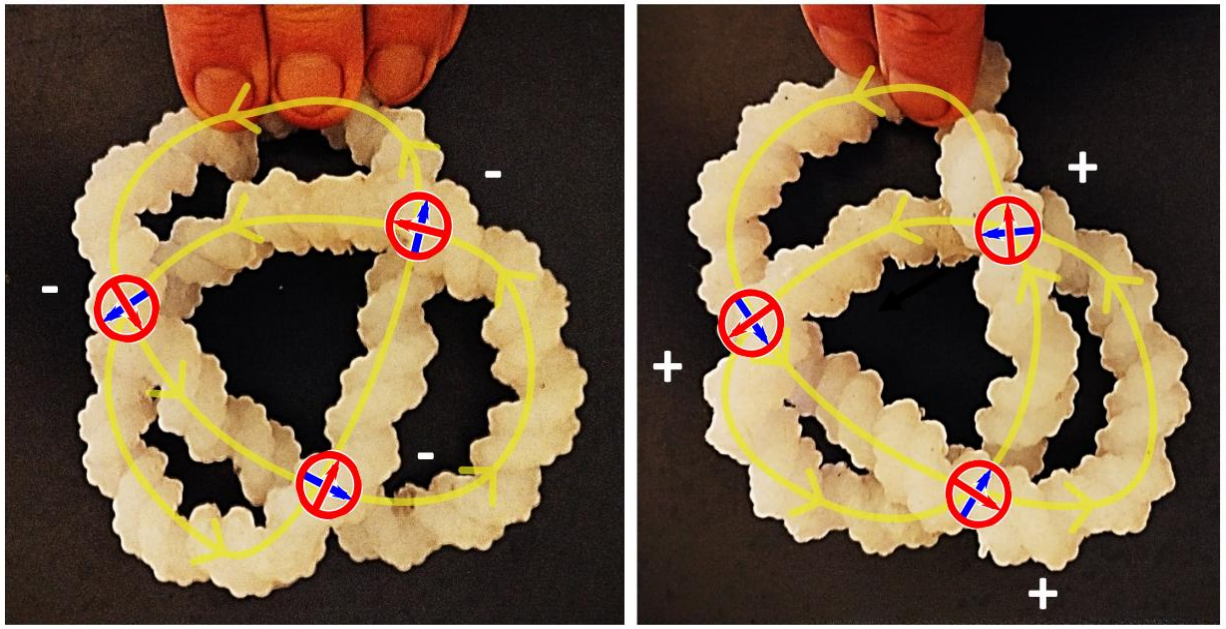
- DNA wrapping
  - Strong bending
  - Chromatin context





Classroom Demo 4: Knotting

- Topology
  - Chirality interplay
  - Mathematics link

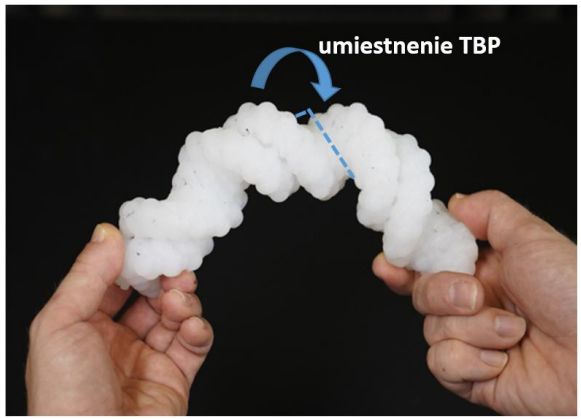


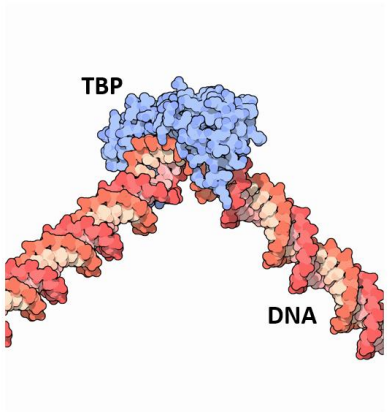
From Biology to Physics

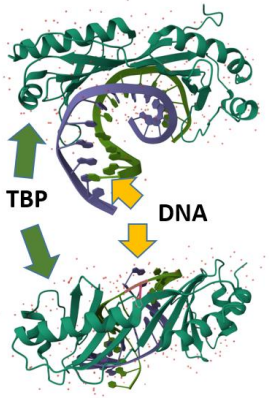
- Forces
  - Energy
  - Elasticity

From Physics to Biology

- Gene regulation
  - Replication
  - Topoisomerases







AI Era Responsibility

- Visual accuracy matters
  - Physical reference model

"GPT, generate me a visually appealing photorealistic DNA chain picture"

AI Era Responsibility

- Visual accuracy matters
  - Contamination of virtual and media spaces

AI Era Responsibility

- Visual accuracy matters
  - Curiosity: The conference logo too!

Incorrect left-handed DNA

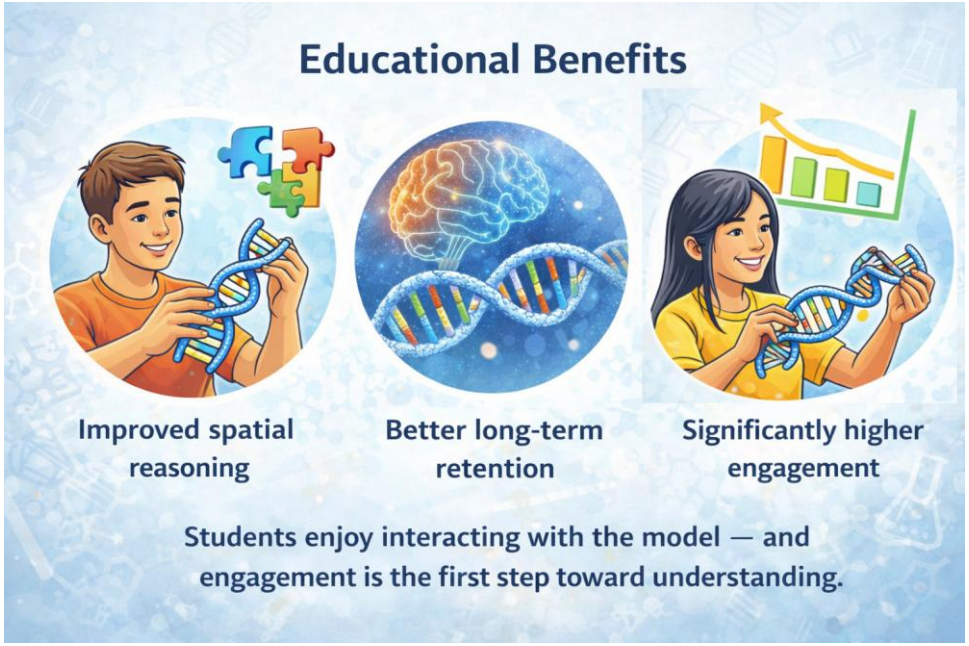
Correct right-handed DNA

Who Can Use EDNA?

- Secondary schools
  - Universities
  - Outreach programs

Educational Benefits

- Improved spatial skills
  - Better retention
  - Higher engagement



Future Educational Extensions

- Chromatin modules
  - Protein-DNA kits
  - Topology workshops

Take-Home Message

- Touch DNA
  - Understand mechanics
  - Strengthen STEM thinking

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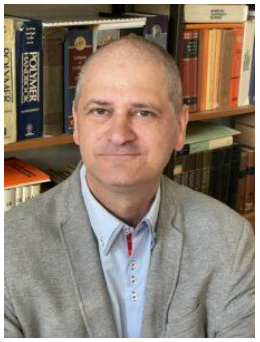
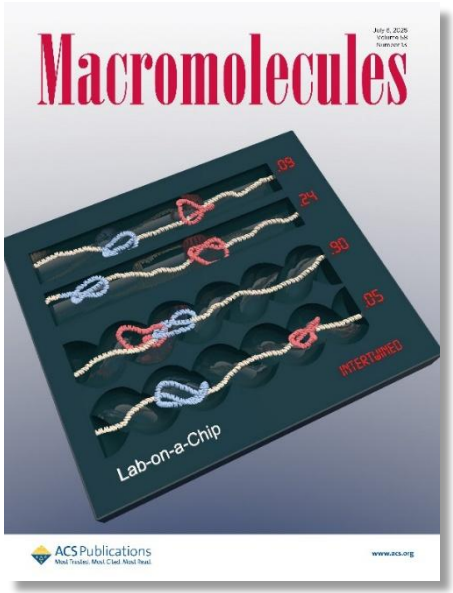
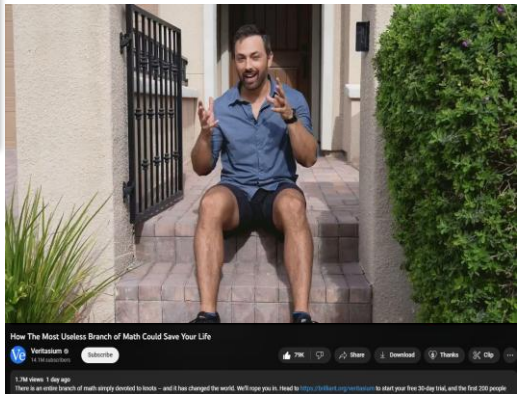


Zdeno Špitálsky **Silvia Podhradská** **Katarína Račková**

Some of our other research:





Our research featured by Veritasium

https://tinyurl.com/PolymerKnots

Ve 42.0 YouTube **10M views**

VEGA

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POLYMERS WITH ACTIVE CHIRAL TOPOLOGY AND NANOTECHNOLOGY

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