How Knot Theory is important to DNA Biology

PRIMES Circle 2020

William Ayinon
About Me

William Ayinon

I am a sophomore at Newton North High School

Interested in Computer Programming, Math, Biology and Chemistry
Knot Theory

- The study of **mathematical knots**
- Theoretical string, ends glued together
Knot Theory Terms

- **Unknot** - The simplest knot, it appears as a circle

- **Deformation** - A change to a knot that does not cut the string or pass it through itself somehow

- **Invariant** - A value that does not change when a knot is deformed
Reidemeister Moves

The **Unknot**

Reidemeister Moves
Crossings and Values

→ **Writhe** - Total **over** crossings minus the total **under** crossings

→ **Unknotted number** - Number of crossings that need to be reversed in order to form the unknot. *Invariant*
DNA Biology Terms

- **DNA** - Deoxyribonucleic acid, a molecule responsible for every biological function within an organism

- **Supercoiling** - When DNA is coiled so tightly that it compresses itself like a telephone cord

- **Enzyme** - Proteins created by living organisms that bring about specific chemical reactions or chemical changes
Knot Theory Applications

- Invariants / Knot Values
- DNA Knot Complexity
- How can we study the enzymes’ work?
Cozzarelli and Brown

*E. Coli* Studies

- Gyrase enzyme
- Rate of work by Gyrase
Benefits

Helps understand how to better manipulate DNA

Developing field

Studying how enzymes replicate DNA

  Cancer drugs try to prevent cell division
Thank you for the support!

★ My parents
★ Peter Haine, mentor and coordinator
★ Kenneth Cox, mentor
★ PRIMES Circle as a whole
Thank You
Sources


