Introduction and applications

MT is a **single molecule** biophysics tools.

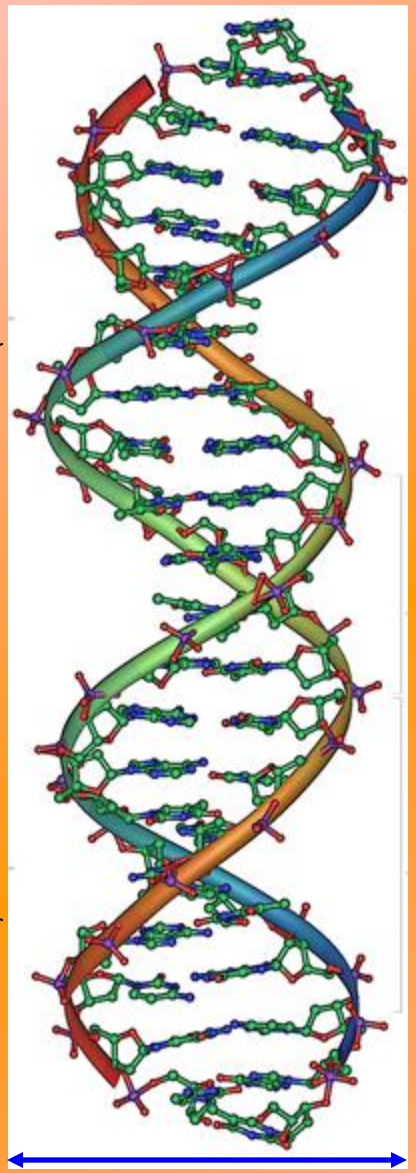
As a s.m. technique, can resolve heterogeneity.

Bending & twisting rigidity of DNA with Magnetic Traps.

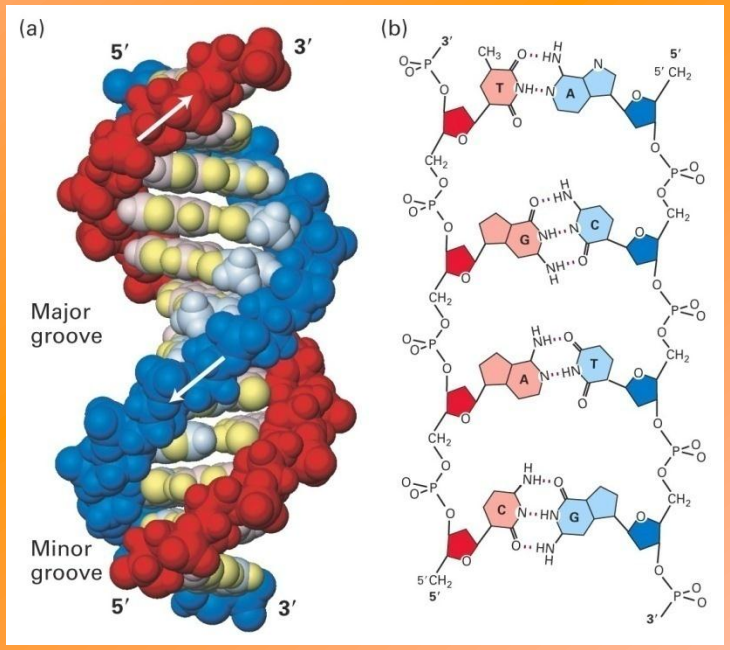
Many slides came from Laura Finzi at Emory University.
Some came from Majid Minary-Jolandan, grad. student at UIUC.
Others from Carlos Bustamante at UC Berkeley.
Helpful comments from David Bensimon.

DNA Structure

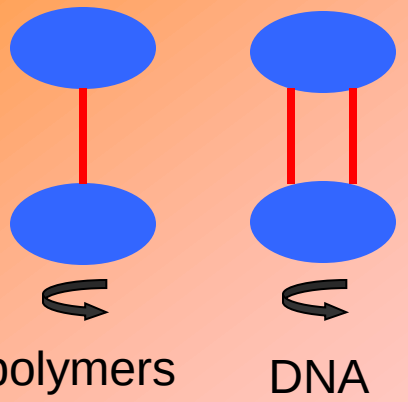
- Right-hand helix
- One turn: 3.4 nm, ~10.5 bp
- Twist angle between bps θ=36



Wikipedia



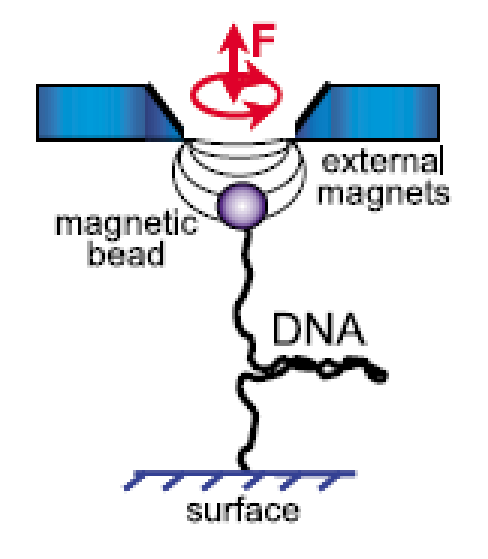
Molecular Cell Biology, Lodish



DNA will resist twisting

Magnetic Tweezers and DNA

Can be conveniently used to **stretch** and **twist** DNA.



With Super-paramagnetic bead, no permanent dipole.

Dipole moment induced, and $\mu \alpha B$. $\tau = \mu \times B = 0$

$U = -\mu \cdot B$

$F = \nabla(\mu \cdot B) : U \sim -\mu B^2$.

It is the gradient of the force, which determines the direction, the force is up. (i.e. where B is highest)

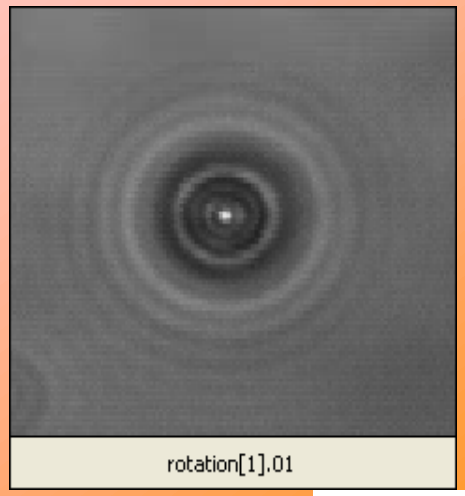
- DNA tends to be stretched out if move magnet up.
- DNA also tends to twist if twist magnets (since μ follows B).

(either mechanically, or electrically move magnets)

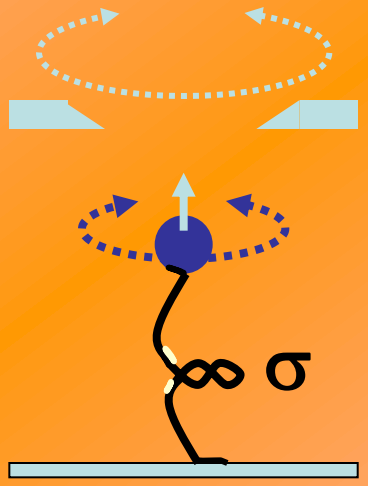
Forces ranging from a few fN to nearly 100 pN: Huge Range

Watch as a function of protein which interacts with DNA (polymerases, topoisomerases), as a function of chromatin: look for bending, twisting.

Magnetic Traps: Measuring twist



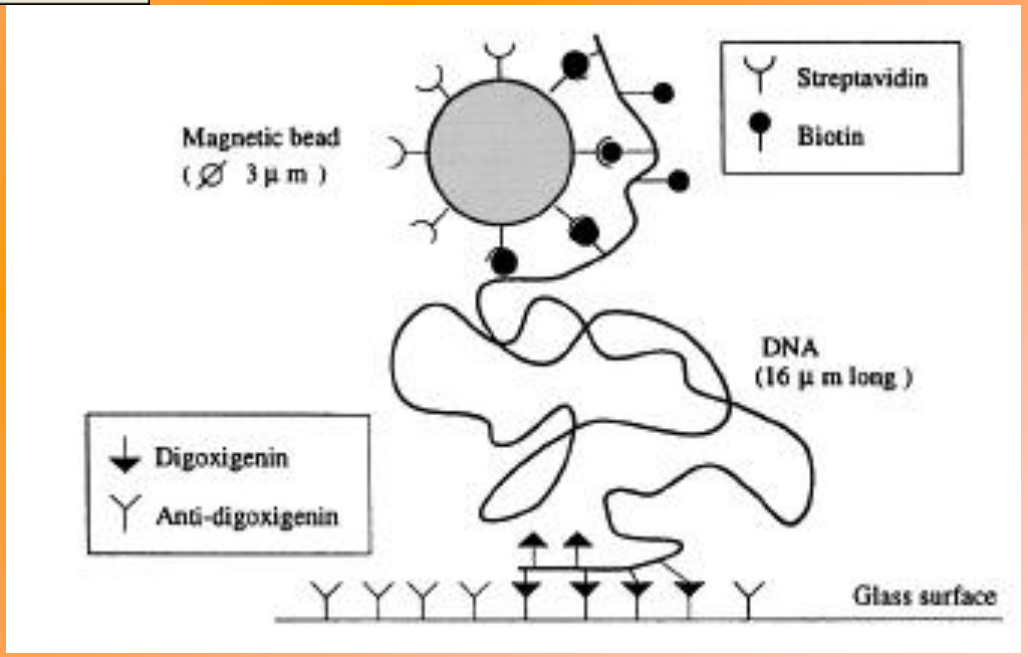
DNA twisting



Twisting leads to motion in x-y plane

Antibody-ligand

Antibody



Class evaluation

1. What was the most interesting thing you learned in class today?

2. What are you confused about?

3. Related to today's subject, what would you like to know more about?

4. Any helpful comments.

Answer, and turn in at the end of class.