3-D Molecular Designs
...where molecules become real ™

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Discovering Dynamic DNA: More than Just As, Ts, Gs, and Cs

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Presenters:

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3D Molecular Designs Chief Science Officer

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Workshop Learning Goals

- Use multiple models to better understand the structure of DNA
- Ask questions to clarify relationships between DNA, the proteins it codes for, and the resulting traits seen in an organism.
- Explain how the expression of genes can be regulated.
- Have fun!

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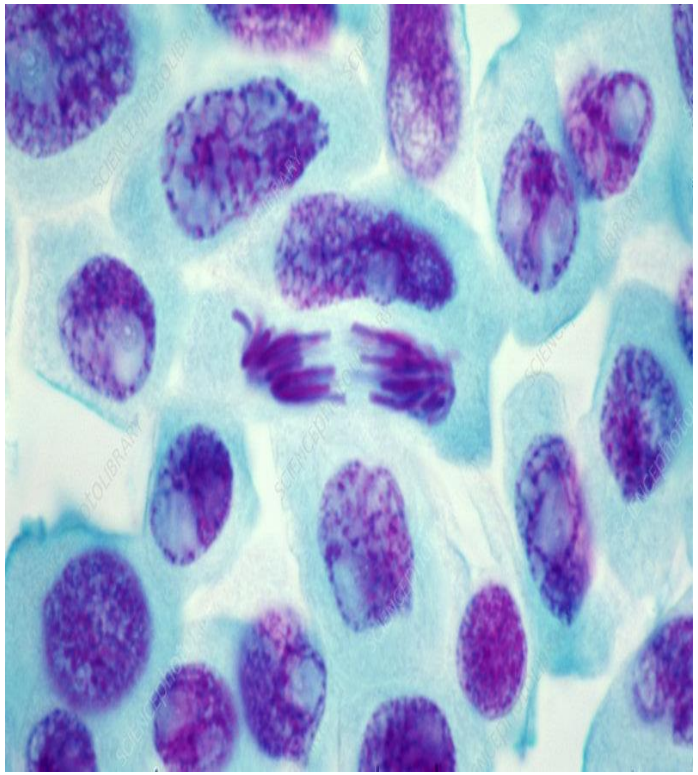
What do you do to help your students understand DNA's role and structure?



Onion-root-Mitosis-scaled.jpg (2560×1918) (valleymicroscope.com)

LiveScience.com

What questions do your students have about DNA and its role in inheritance?

File:Young beagle at rest.jpg - Wikimedia Commons

File:A sample of brown eyes.jpg - Wikipedia

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Using the DNA Starter Kit:

What do I notice about the model?

What do I wonder?

What two questions do I have?

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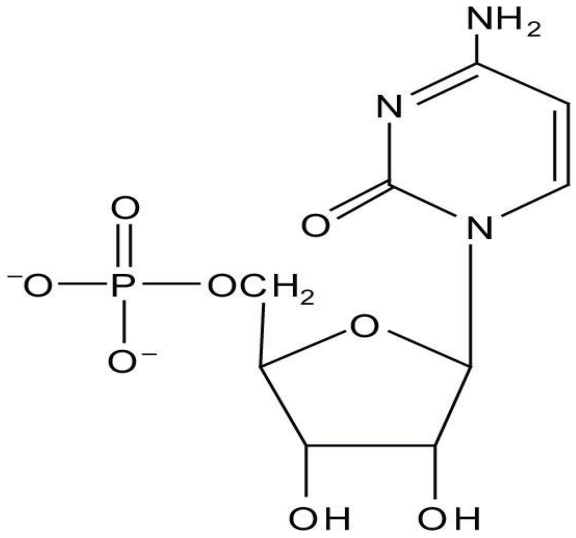
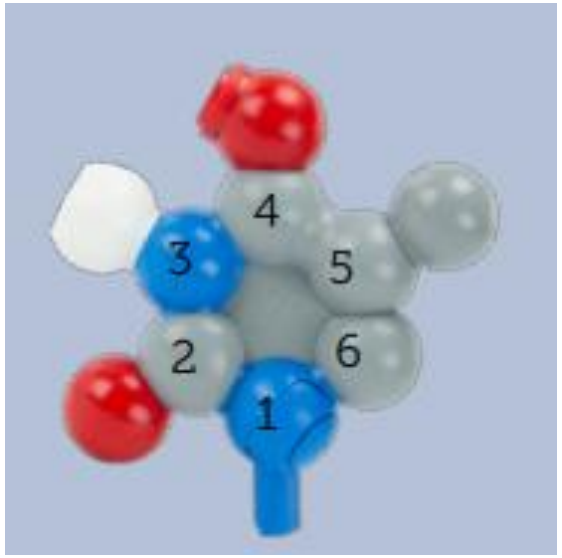
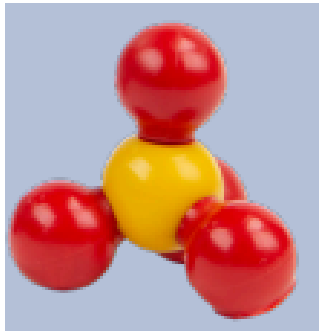
Without using magnets, assemble the model

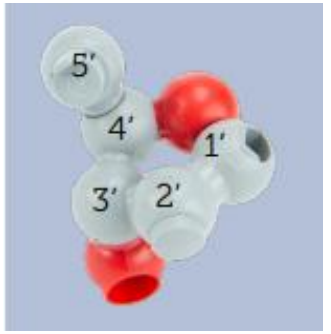
- What do you notice about the model?
- Compare it with those at your table. How are they the same?
- How are they different?

Let's have a closer look at the structure

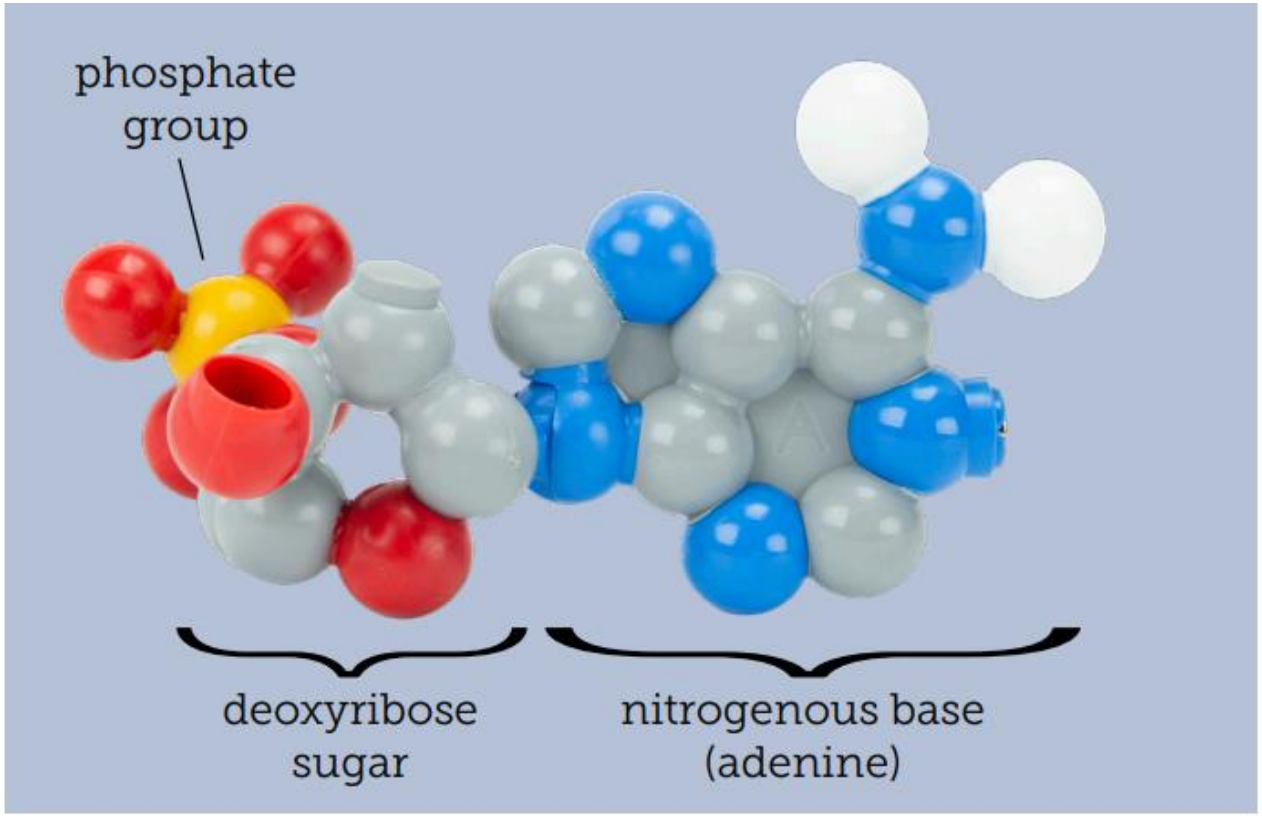


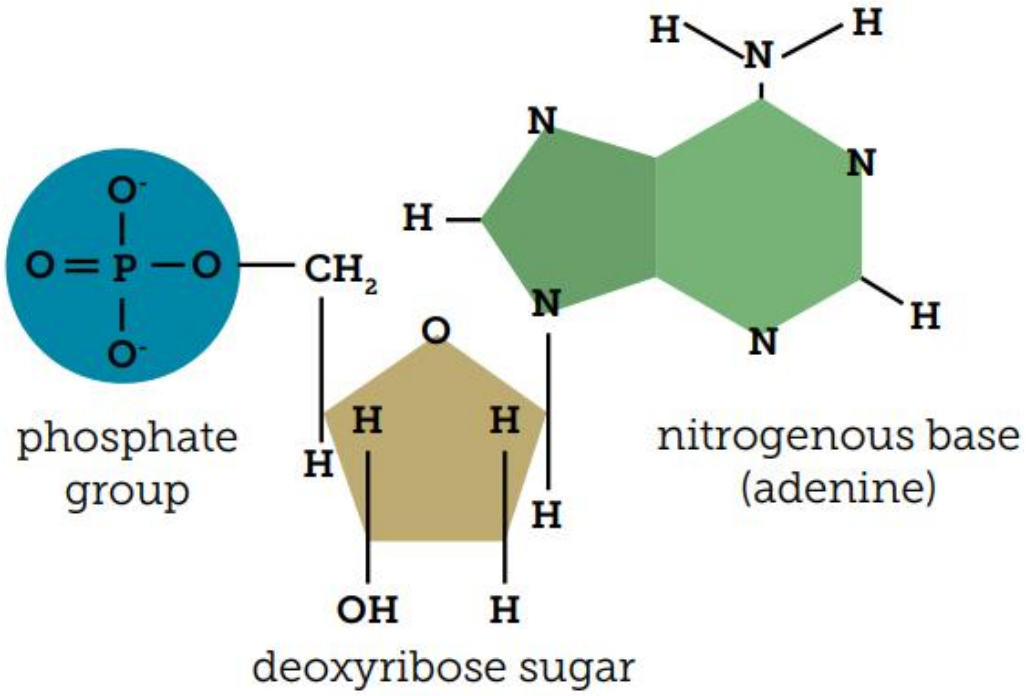






Let's have a closer look at the structure





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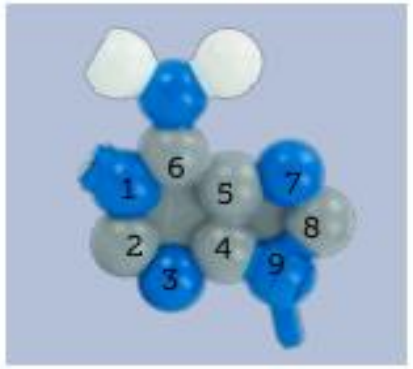
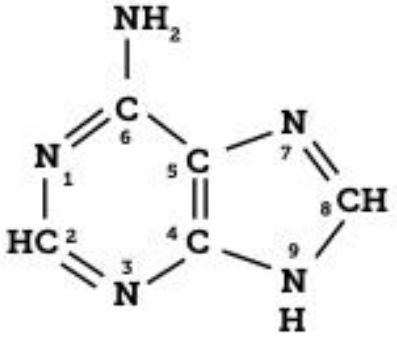
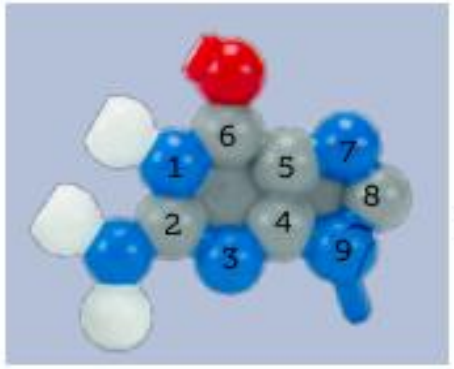
Using the magnets, find your nucleotide pair

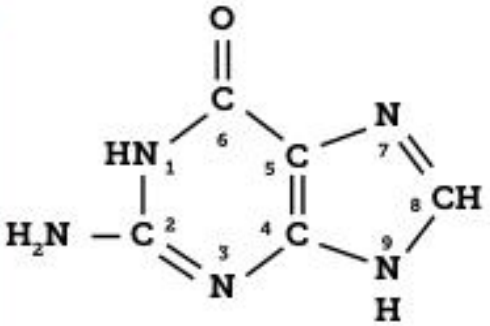
Purines





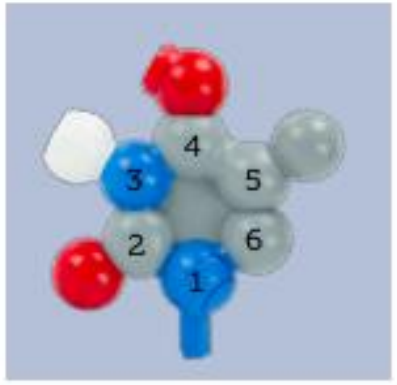
adenine (A)

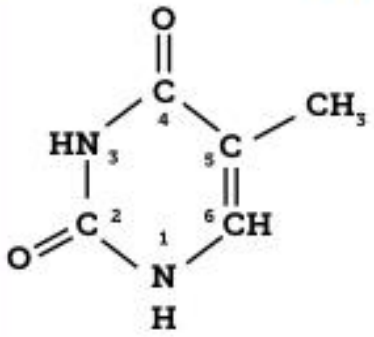




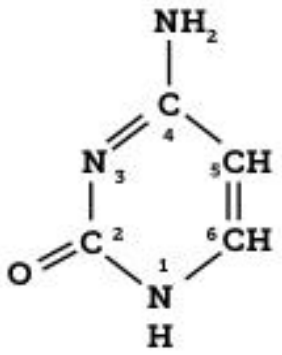
guanine (G)

Pyrimidines



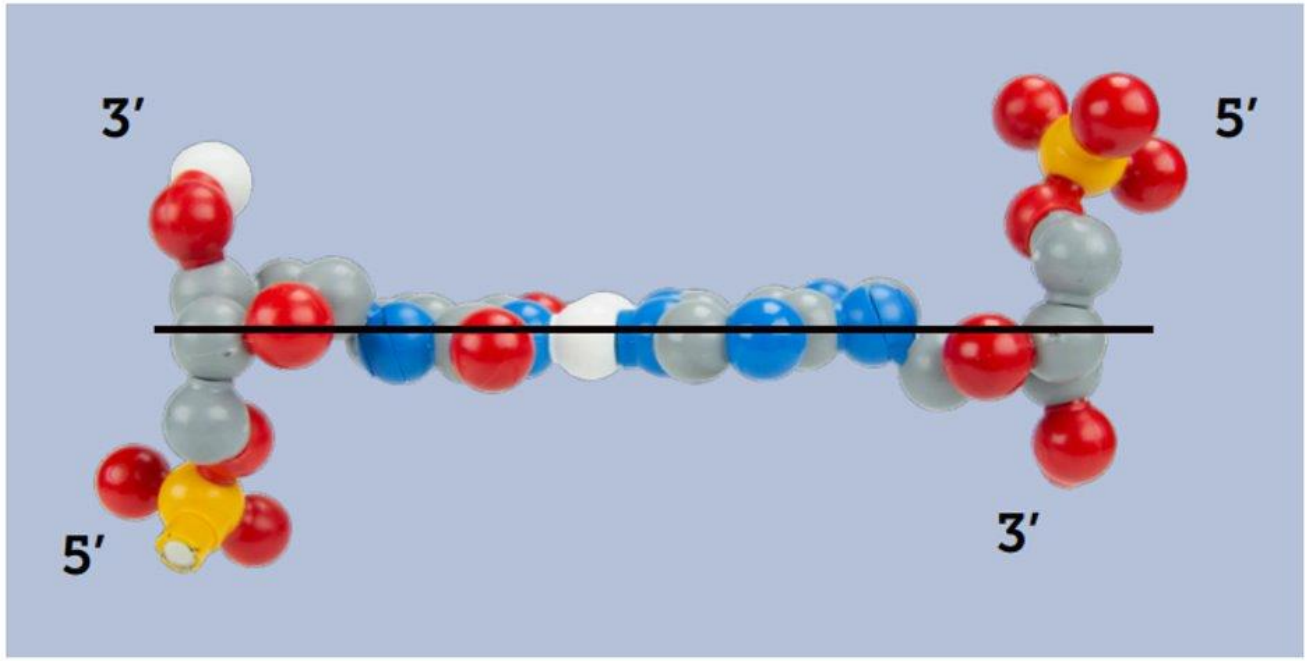


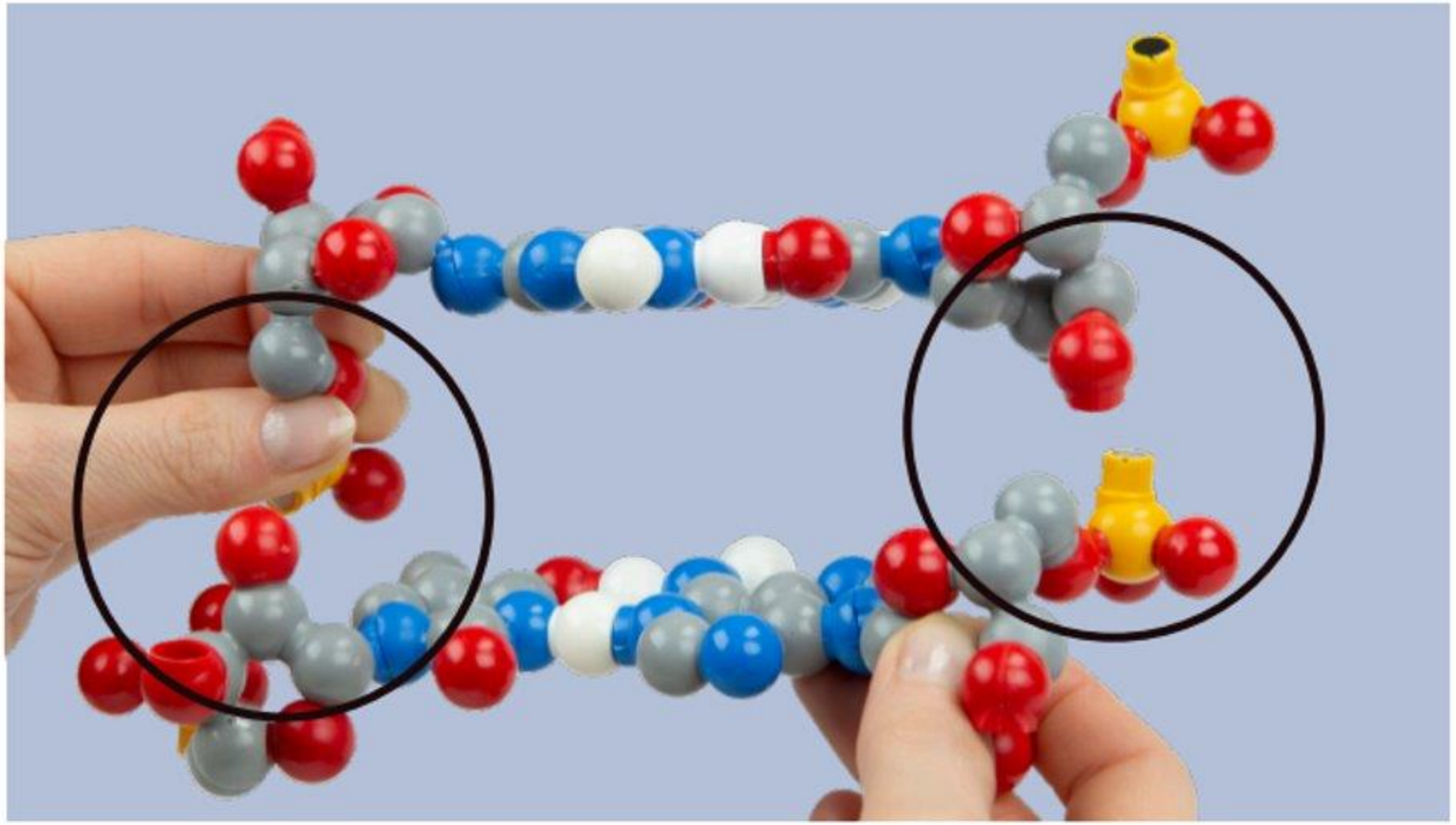
thymine (T)



cytosine (C)

A closer look at the model





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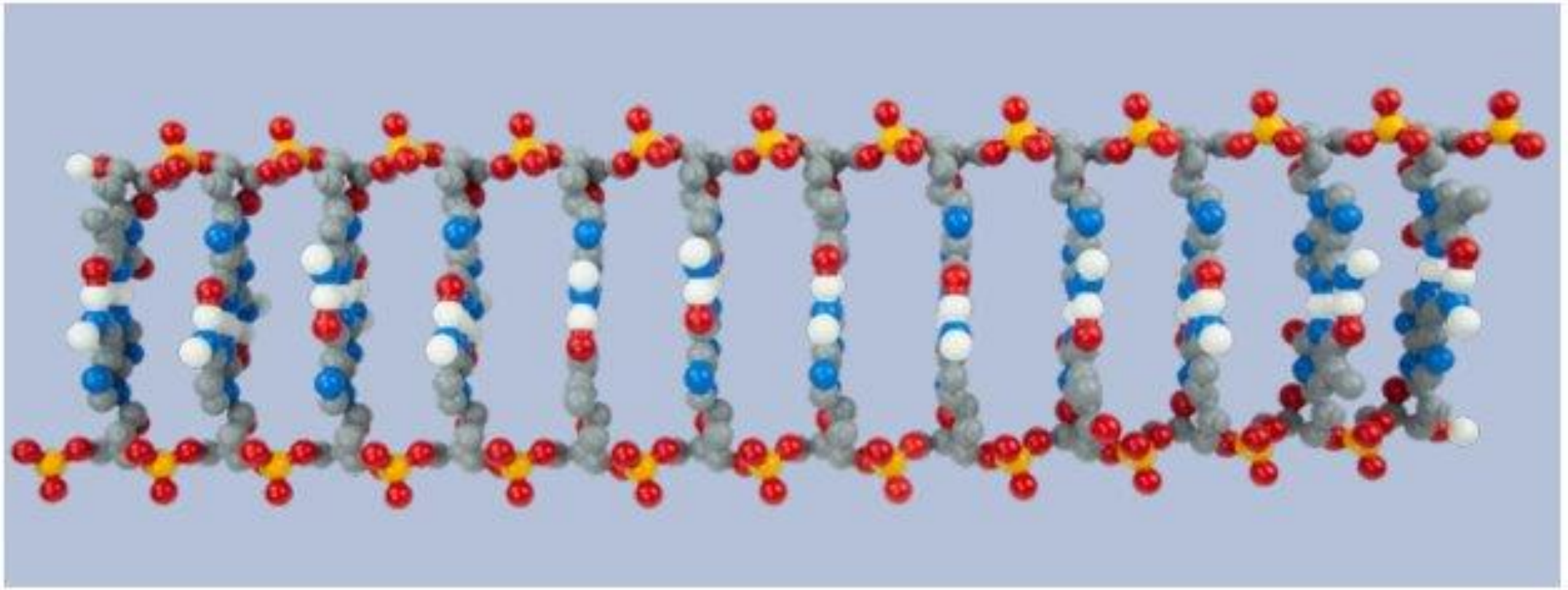
What do you notice? What do you wonder?



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Comparing models

- Why is it necessary to use multiple models?
- What do each of these model represent?
- What did the model do well?
- What was lacking in the model?
- How can the model be improved?

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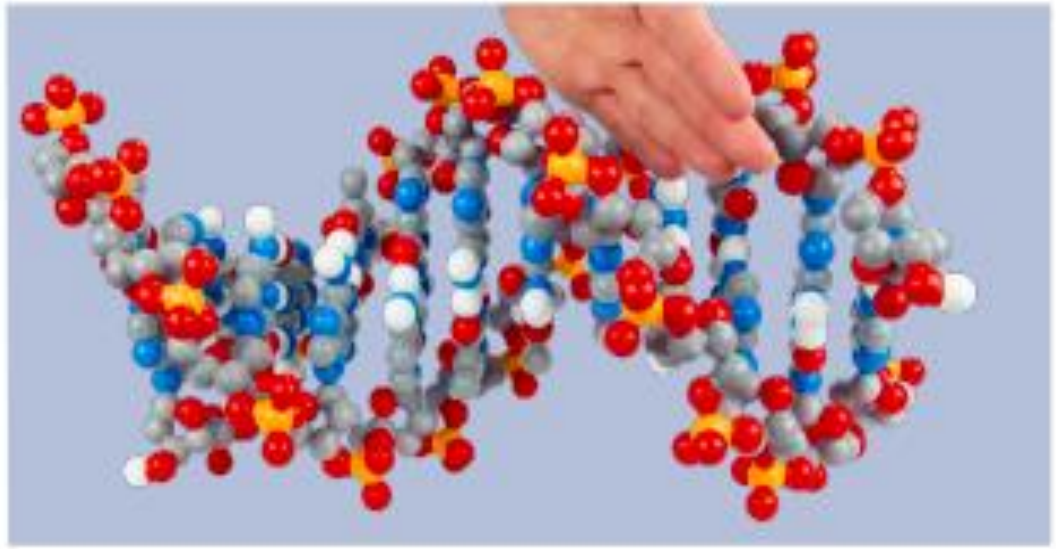
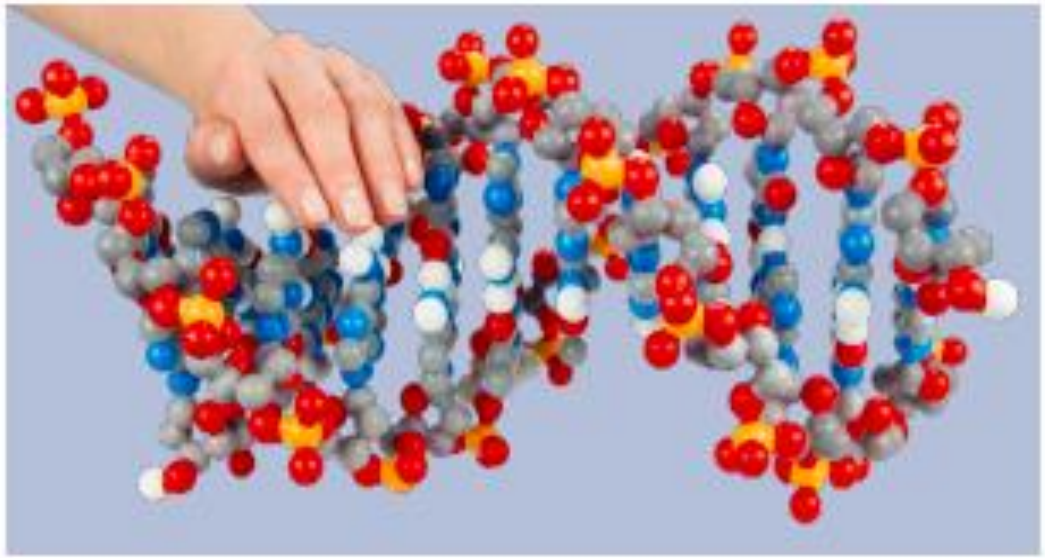
A closer look at the model

minor groove

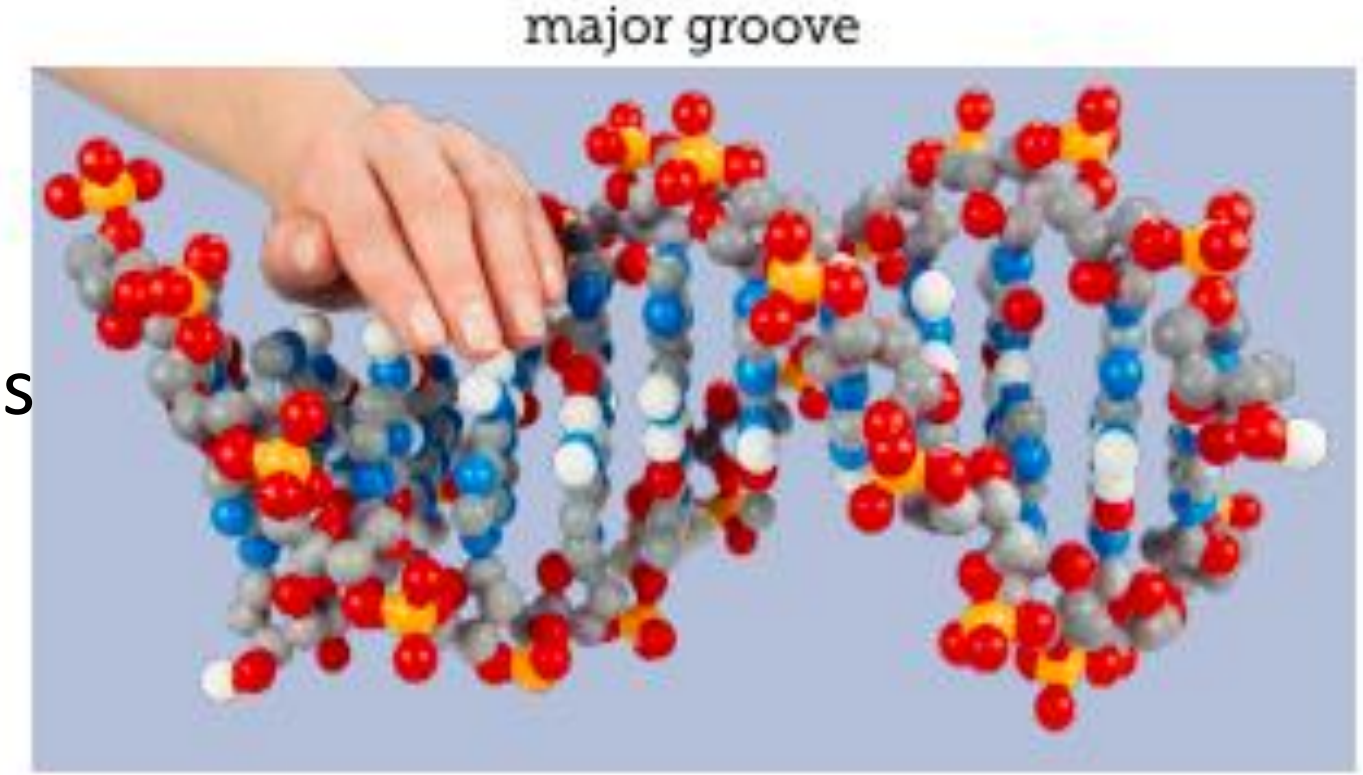


major groove



A closer look at the model

- The alpha helix of a protein can fit in the groove
- Amino acid side chains can interact with the nucleotides
- Leads to Sequence-specific interactions
  - DNA binding proteins
  - Transcription factors



DNA Structure

Genetics…

The Flow of Genetic Information…

The Genetic Code…

Replication…

Transcription…

Protein Synthesis…

Bioinformatics…

Genomics…

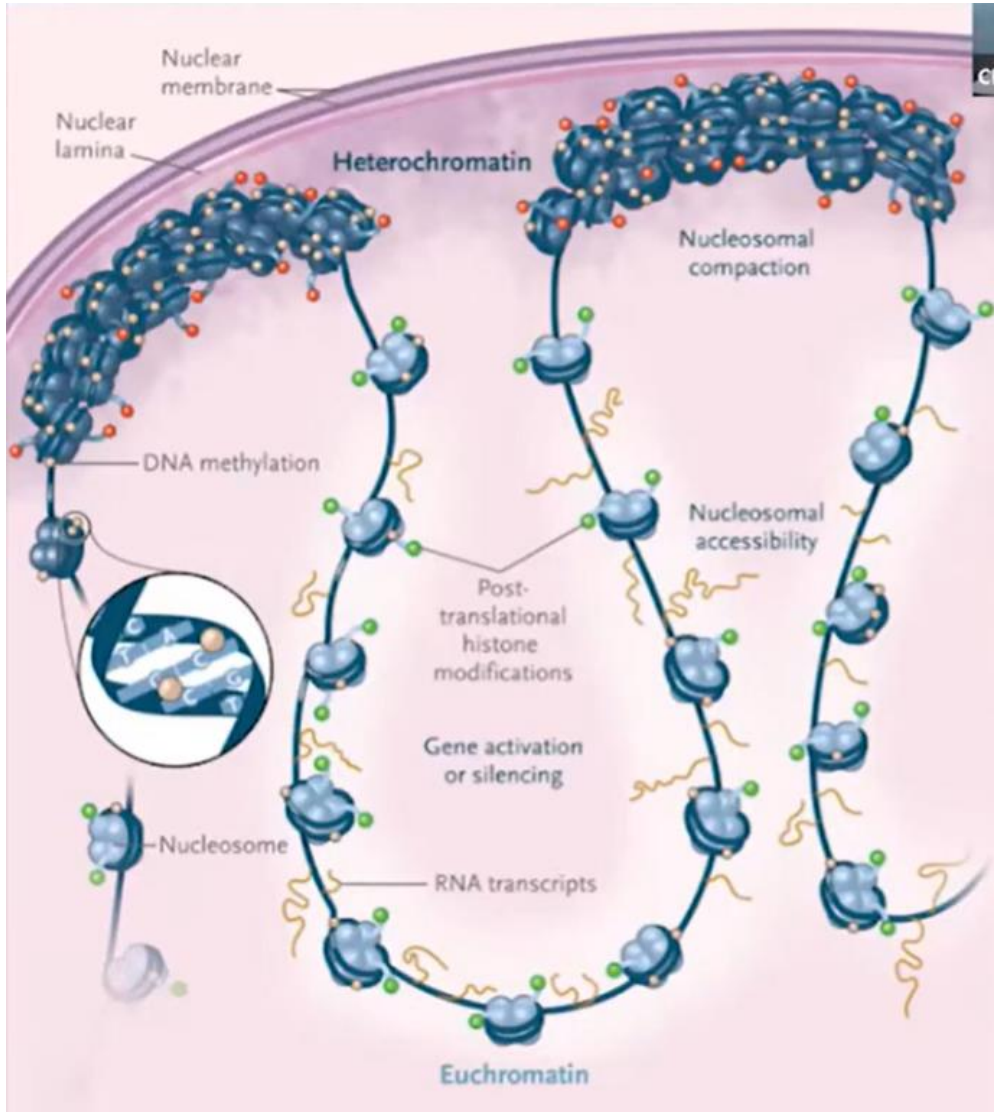
Editing Genomes…with CRISPR…

Epigenetics…

Epigenetics is....

...the chemical modification of both DNA and histones...

...to regulate gene expression.



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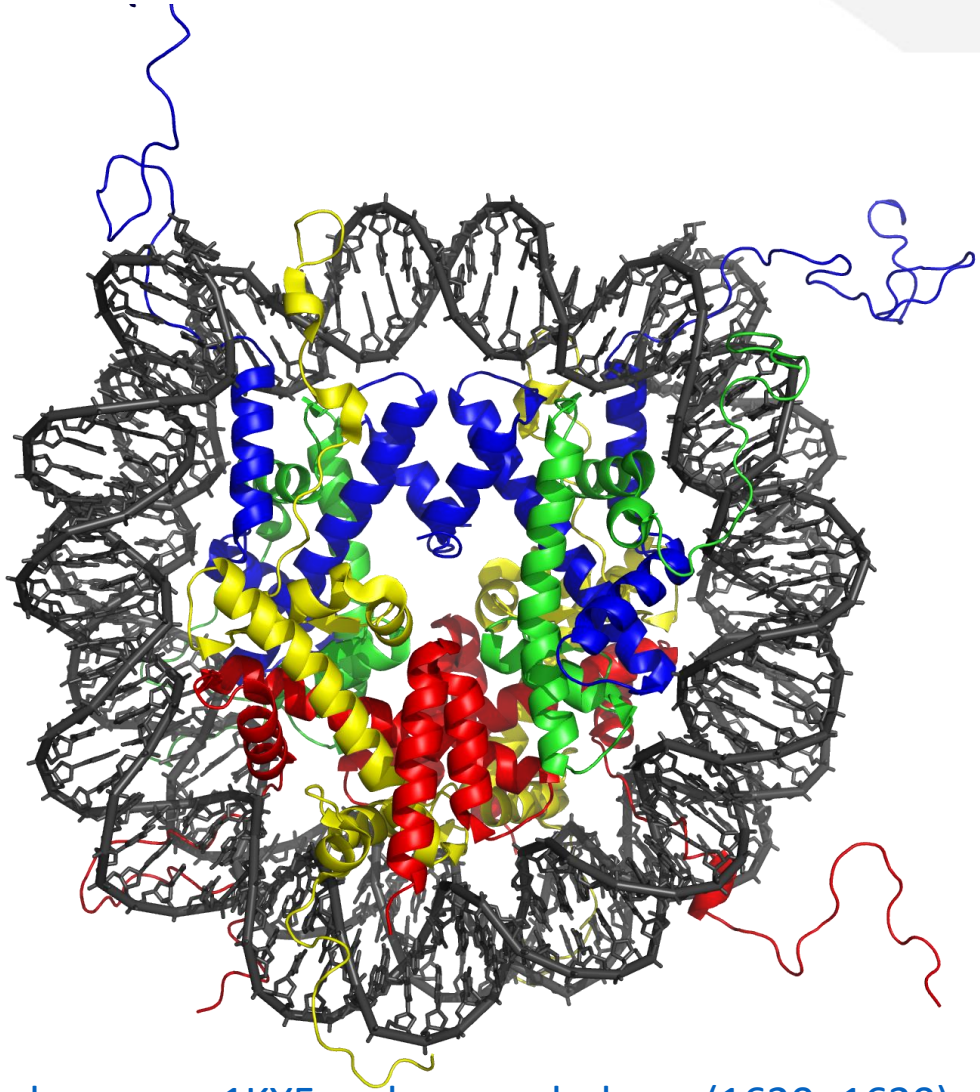

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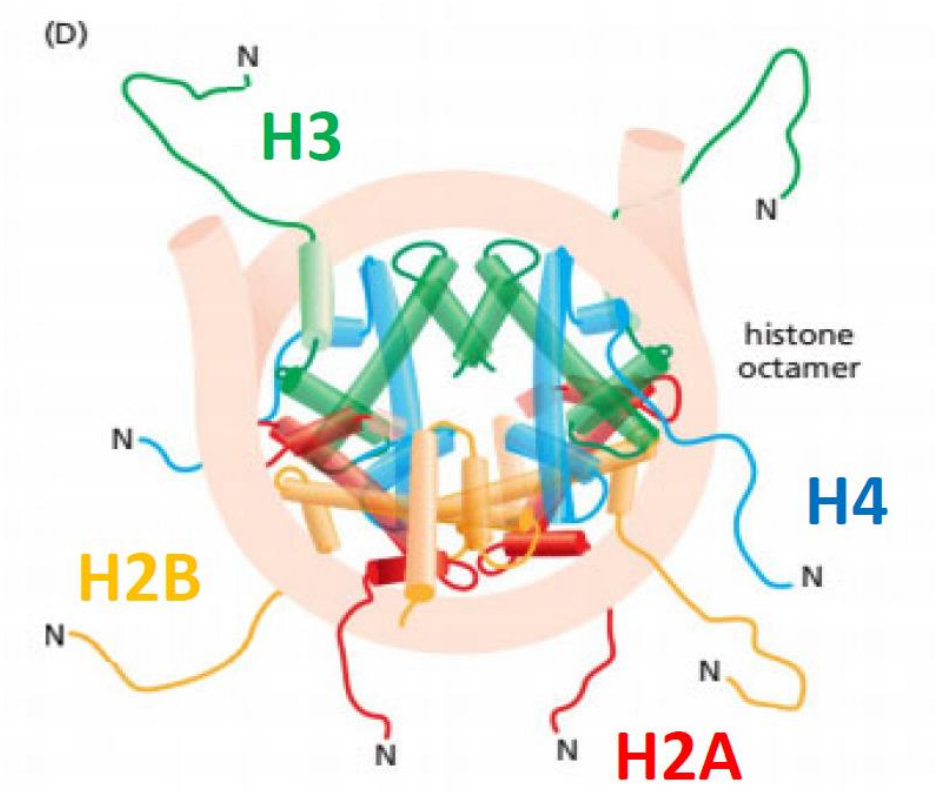
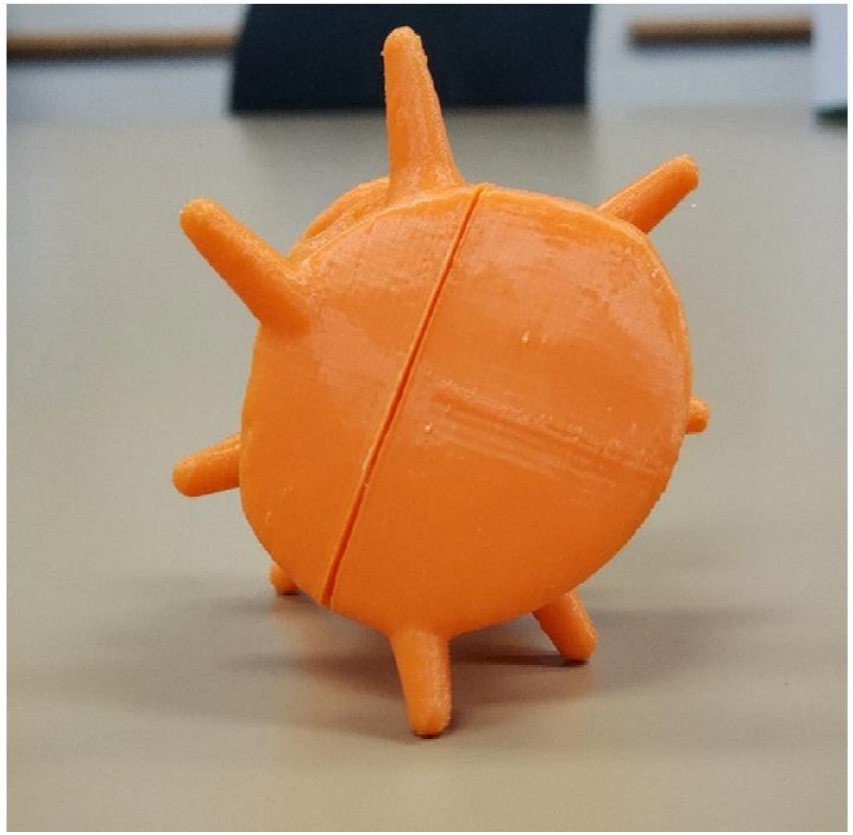
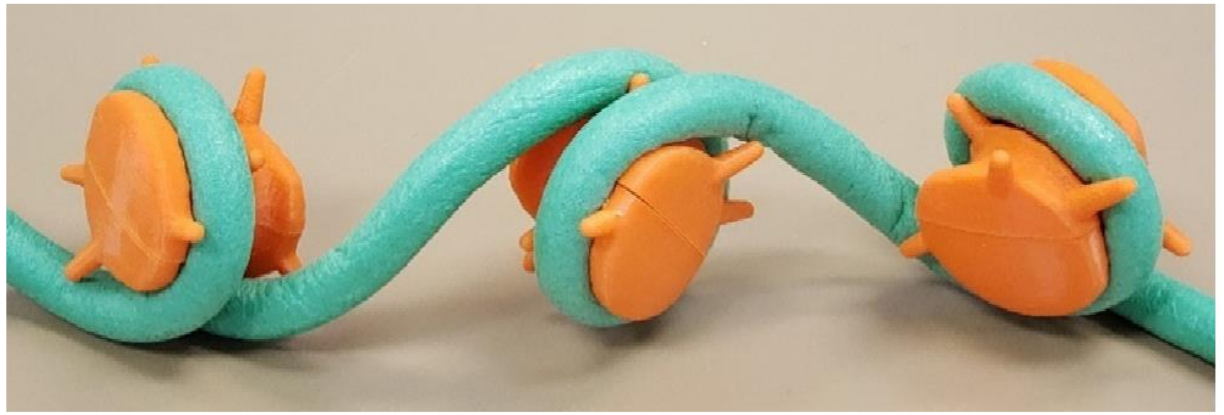
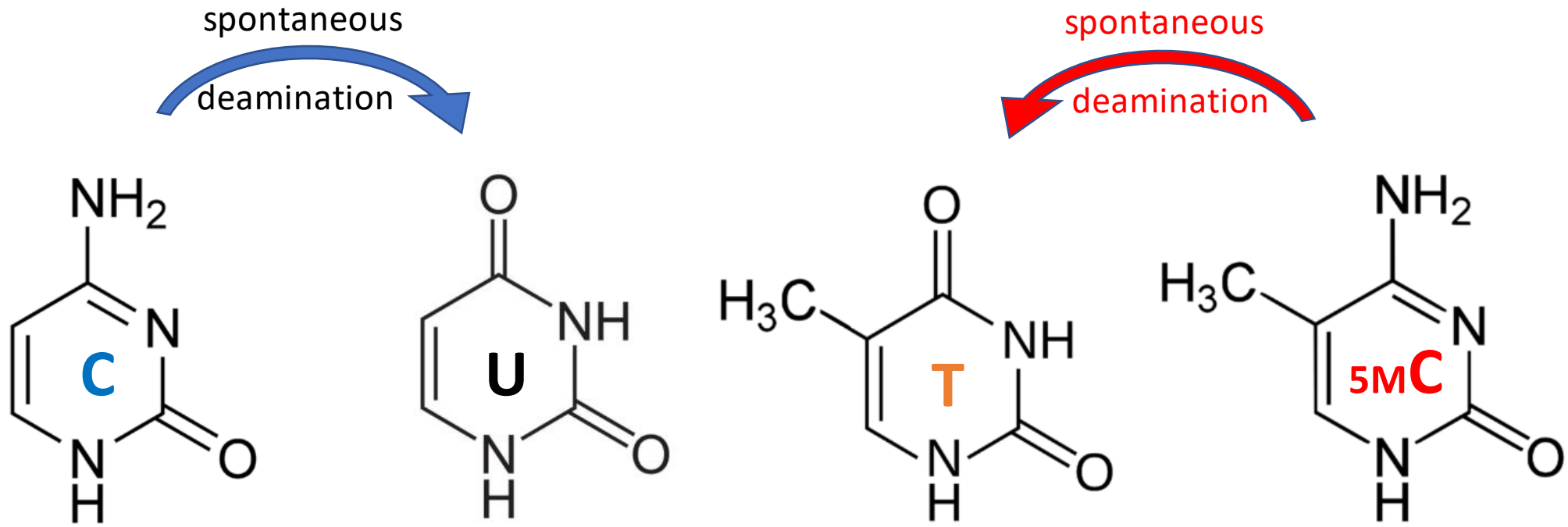

(D)
N
H3
N
histone
octamer
N
H4
N
H2B
N
N
N
N
H2A



Heterochromatin



Euchromatin



Cytosine **Uracil** **Thymine** **5-Me-Cytosine**

Uracil N-glycosidase removes U's from DNA

Methylation of CpG.....

Where are these methyl groups...in double-stranded DNA???

DNA Methylation

The dinucleotide CpG should occur every 16 nucleotides in DNA.

In fact, it is only found once in every 100 nucleotides.

So,… where have all the CpG's gone?… long time passing.

https://www.youtube.com/watch?v=9yWt4IYoQoI

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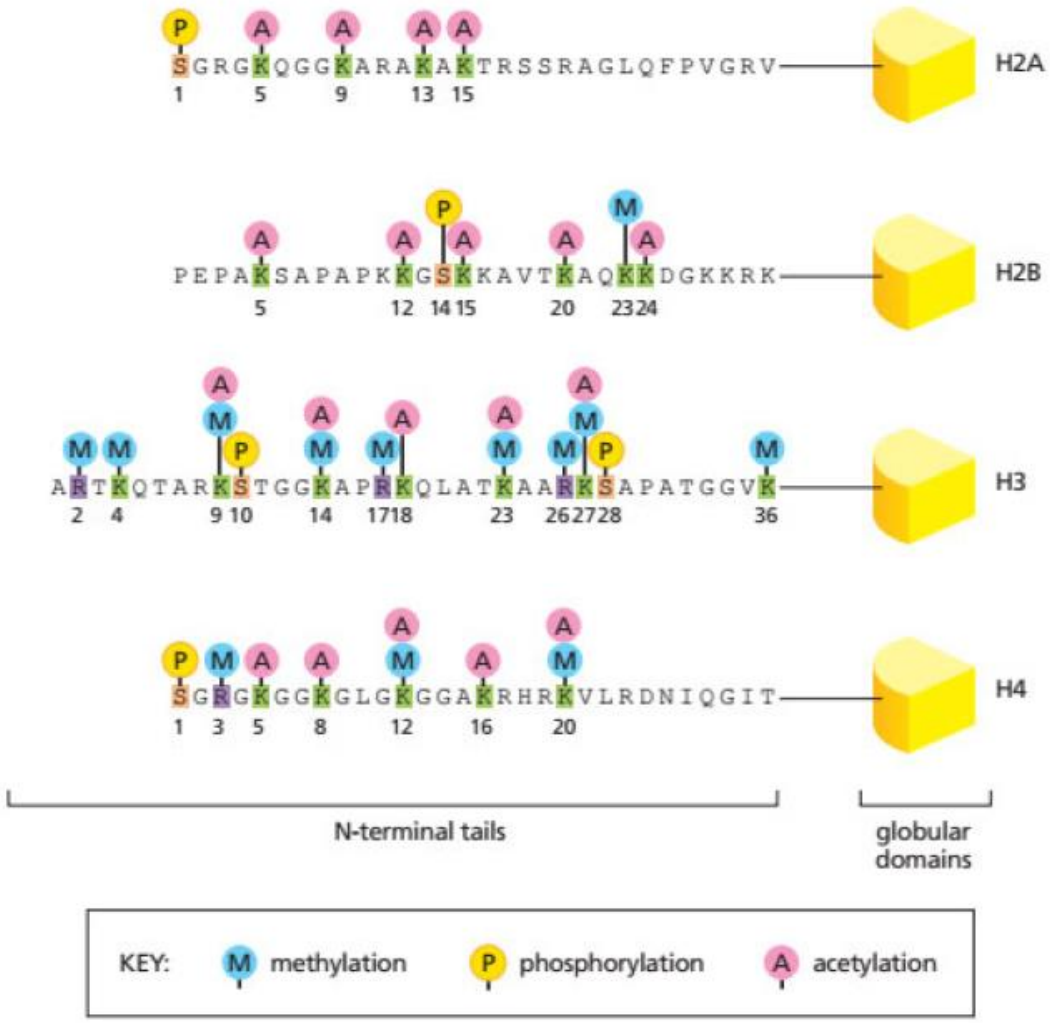
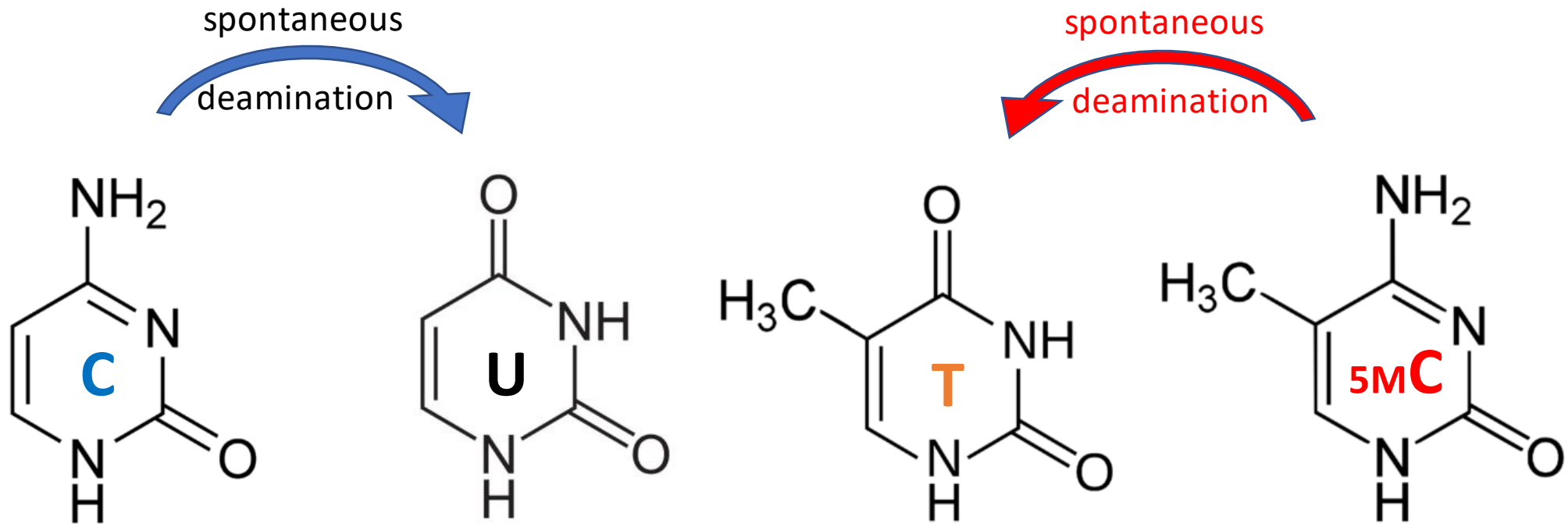
Histone Modifications.....



Life is Complicated.....



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Workshop NGSS Connections

SEPs	CCCs	DCIs
Asking Questions and Defining Problems	Cause and Effect	HS-LS1-1 Structure and Function
Developing and Using Models	Scale, Proportion, and Quantity	HS-LS3-1: Inheritance of traits
Constructing Explanations and Designing Solutions	Structure and Function	
	Science As a Human Endeavor	