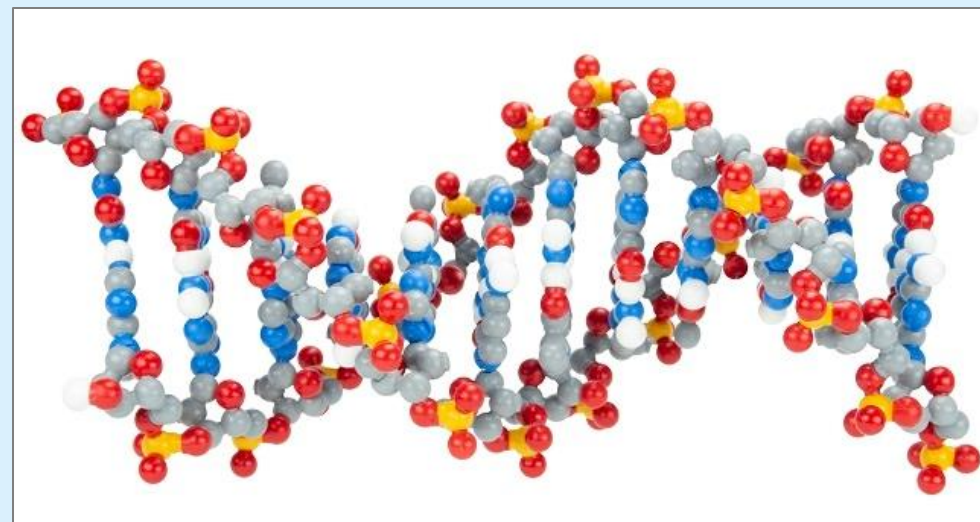


Discovering Dynamic DNA: More than Just As, Ts, Gs, and Cs





Mark Arnholt
Science Educator
3D Molecular Designs

BA Secondary Education
BS Biology
Broadfield certification

PLTW Instructor (PBS, MI, BI)
SMART Team Advisor
Fishing Club Advisor

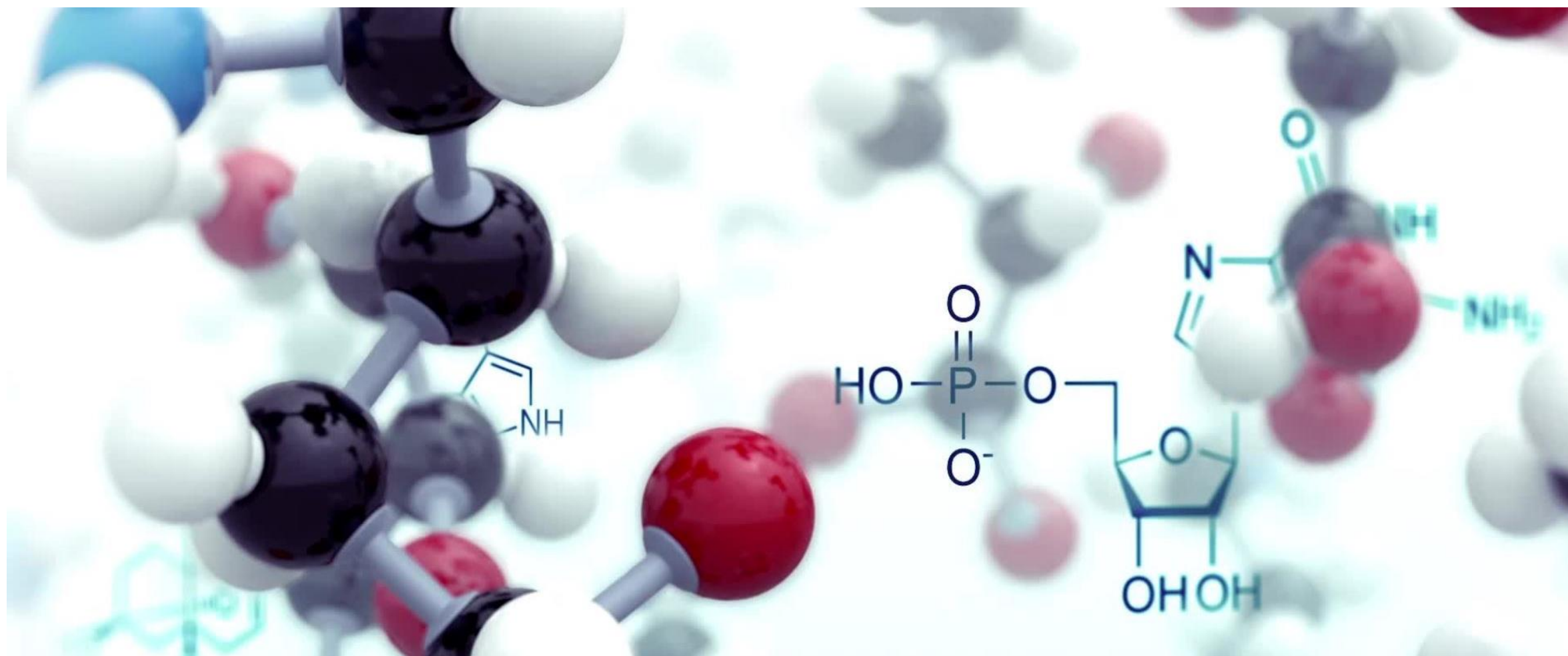
24 years in the classroom
Hartford Union High School
2001-2022





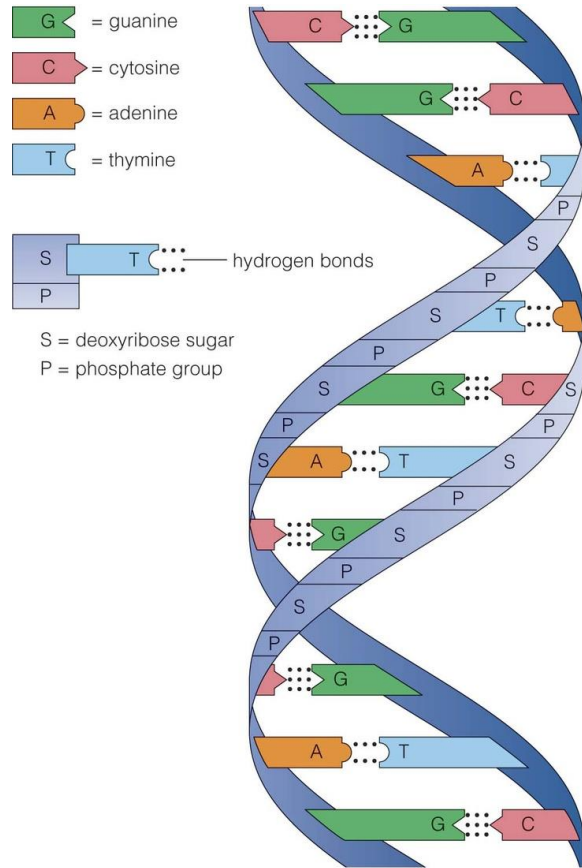
Workshop Learning Goals

1. Facilitate DNA exploration and question generation
2. Use models to help students develop a deeper understanding of DNA Structure
3. Discover other uses for the Dynamic DNA kit
4. Have fun!



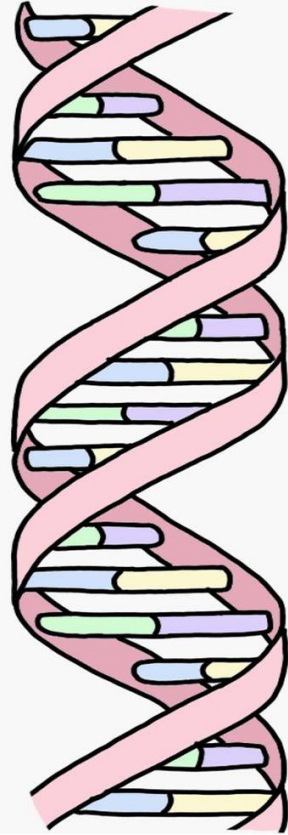


Which of these models do you use in your classroom?

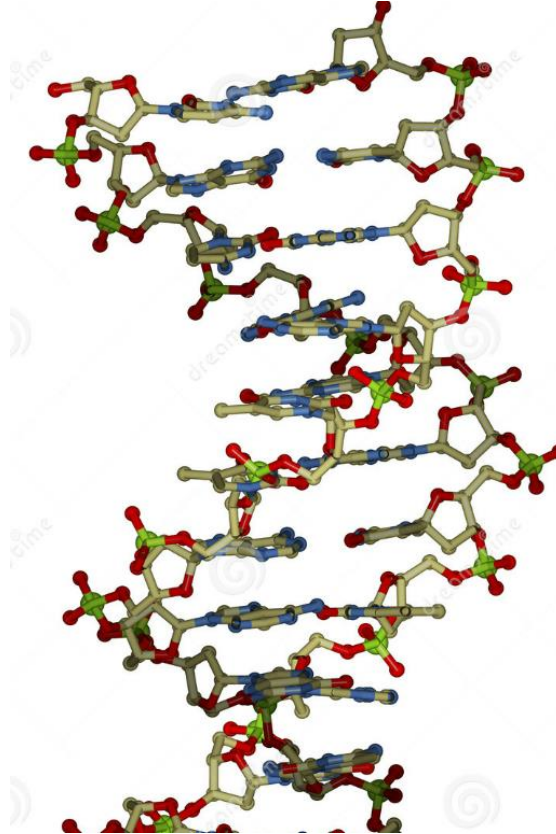


© 2004 Wadsworth - Thomson Learning

1



2

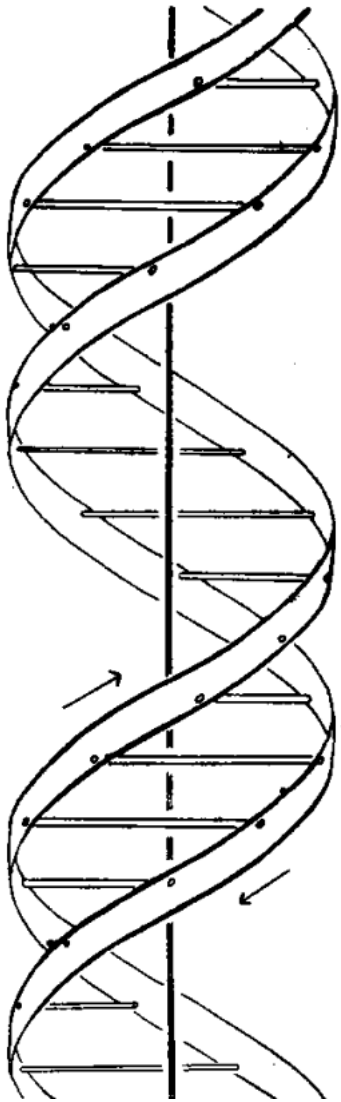


3



4





Where it all began...

April 25, 1952 – Publication
in Nature by Watson and
Crick suggesting a double
helix structure

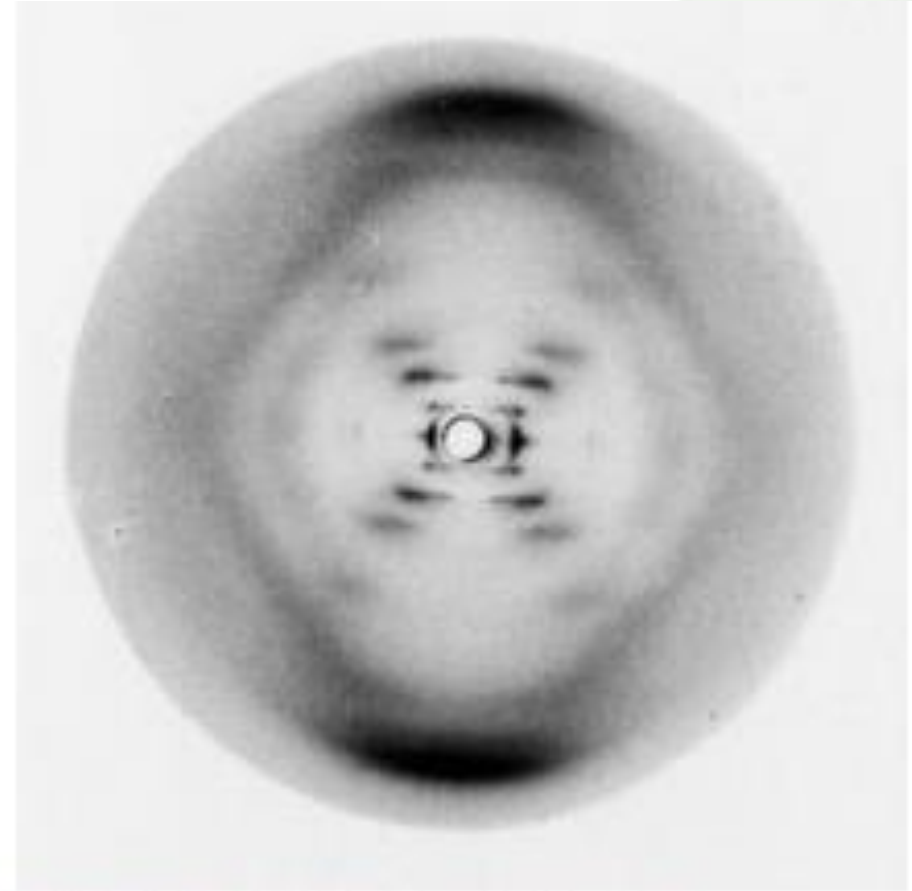




Rosalind Franklin's Photo 51

DNA is way too small to see with light!

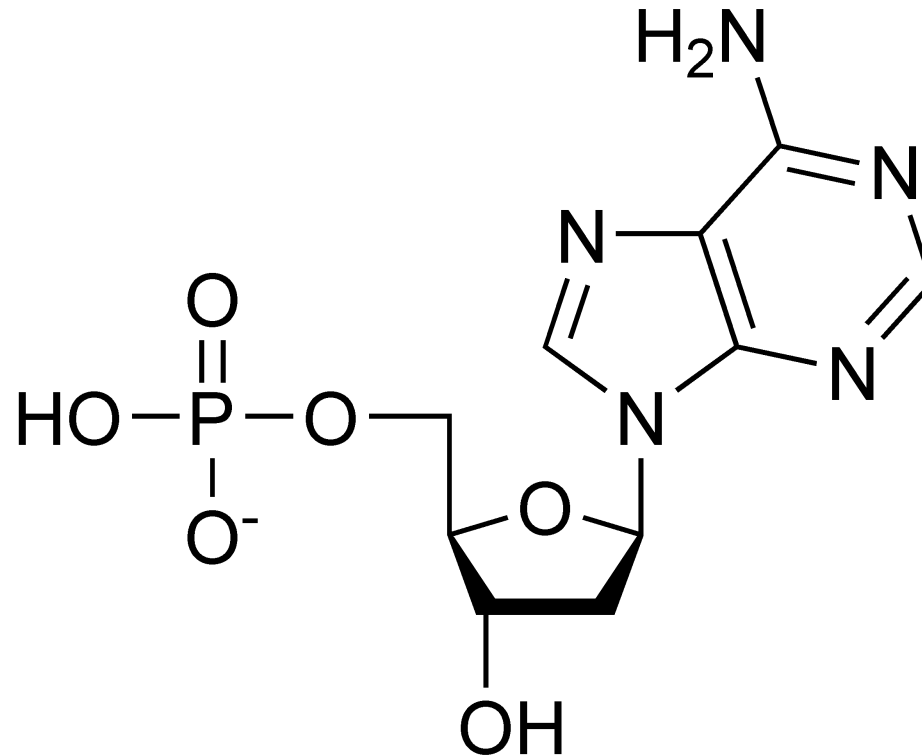
X-ray Diffraction of a crystal
is used to determine the structure



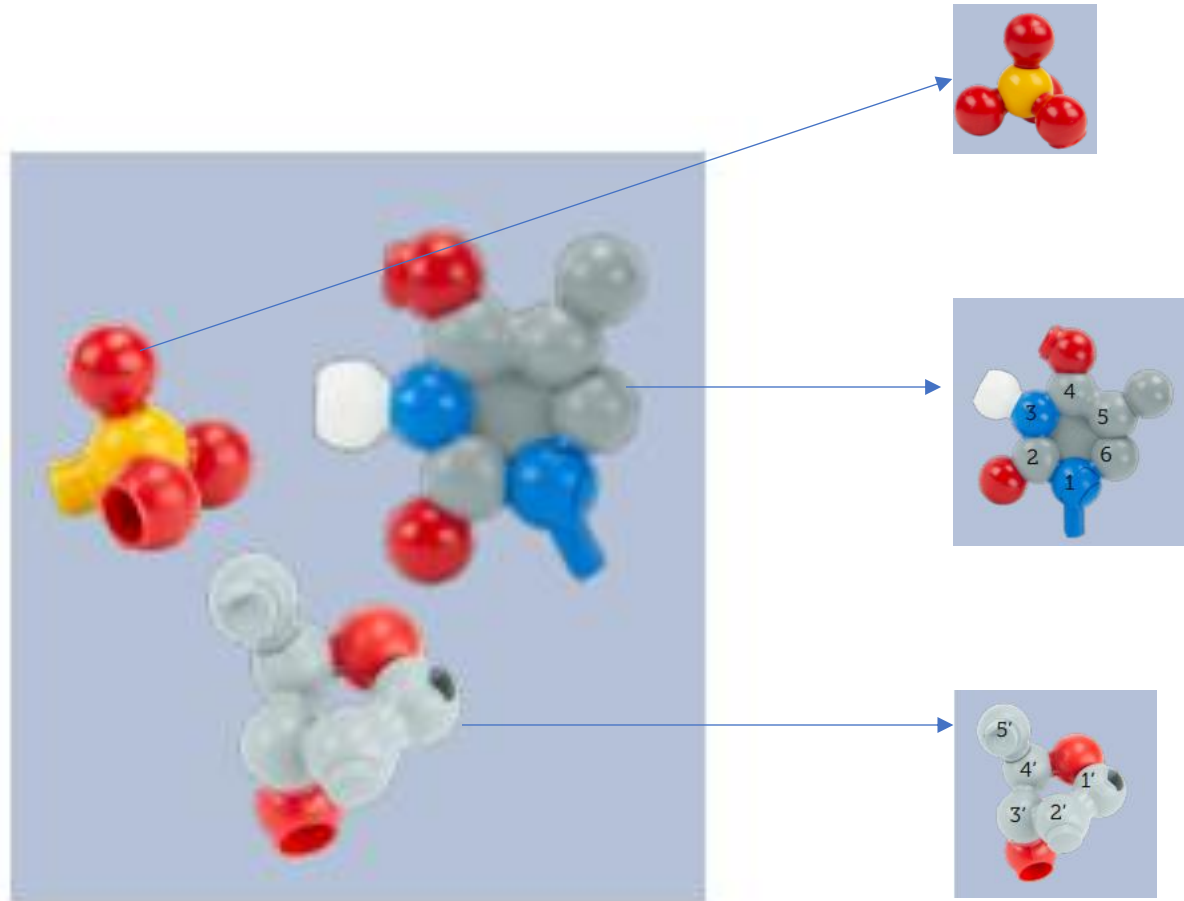
[https://www.bbc.com/news/
health-18041884](https://www.bbc.com/news/health-18041884)



- Take a look at a single nucleotide.
- What are some observations you can make?



Let's deconstruct a single nucleotide

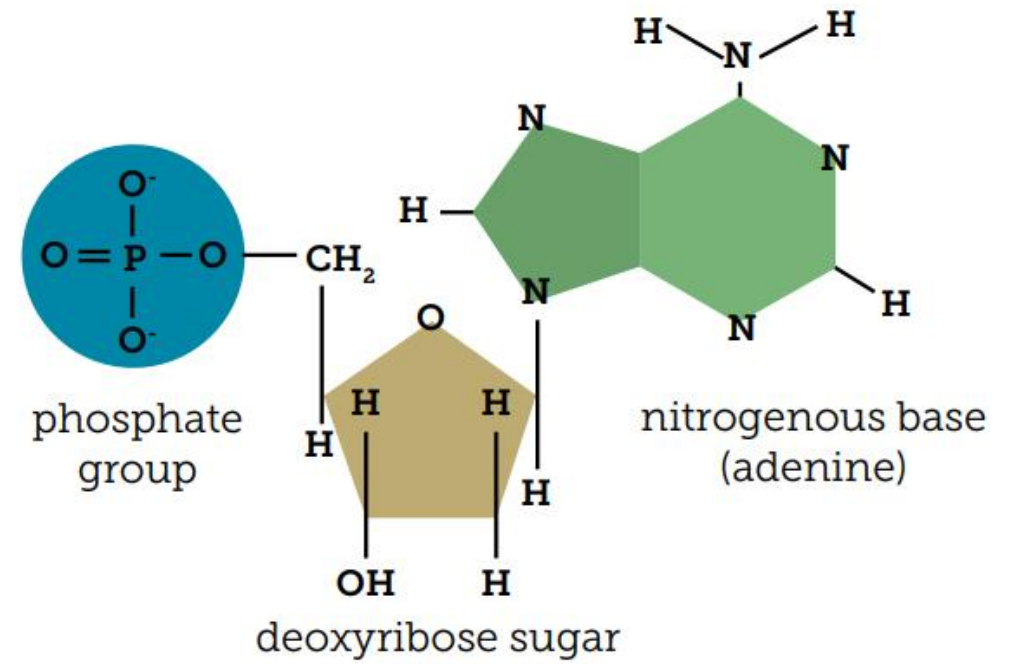
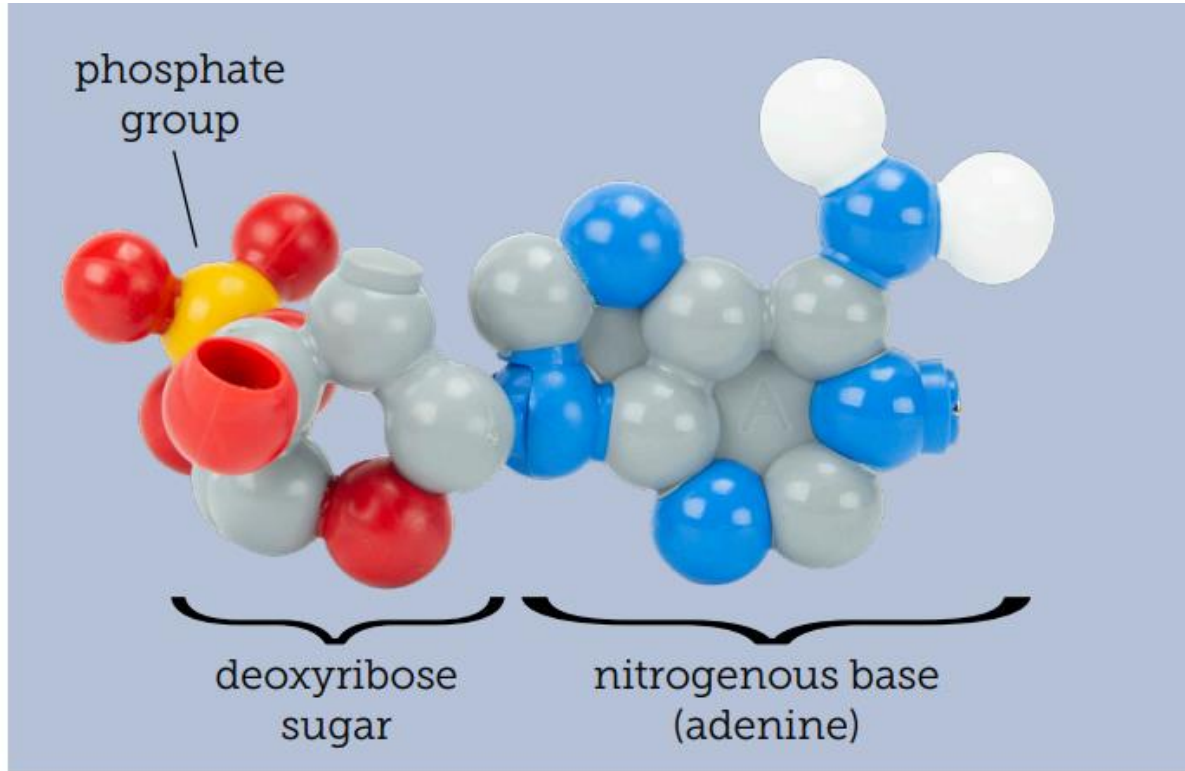


Phosphate group

Nitrogenous Base (Thymine)

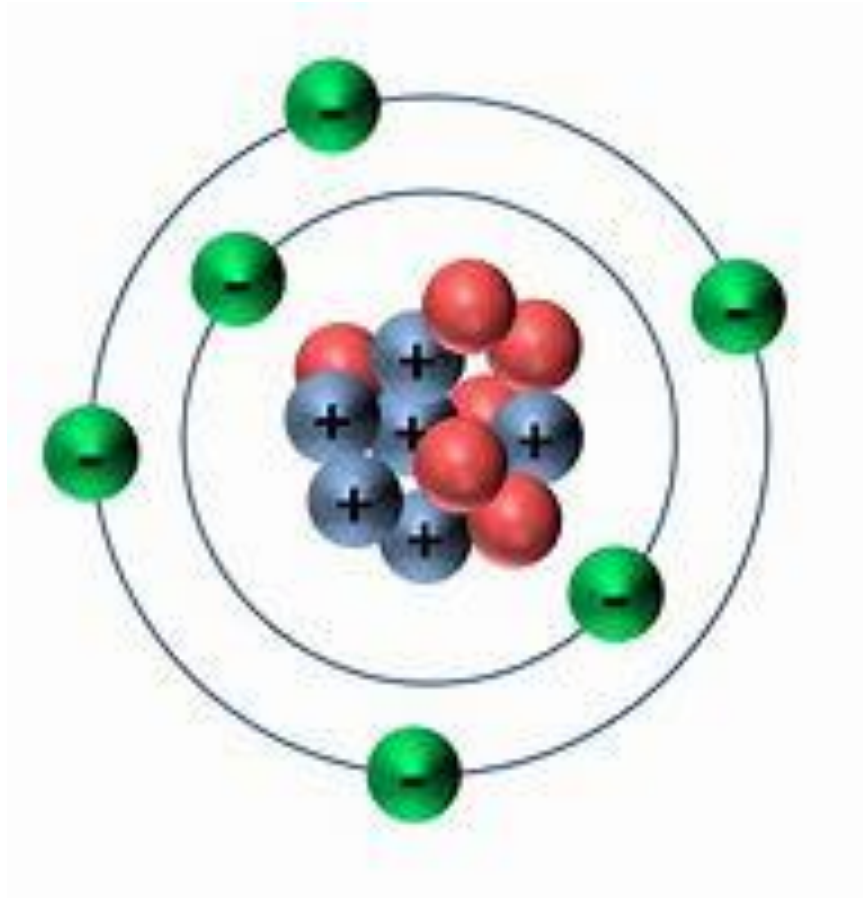
Sugar - Deoxyribose





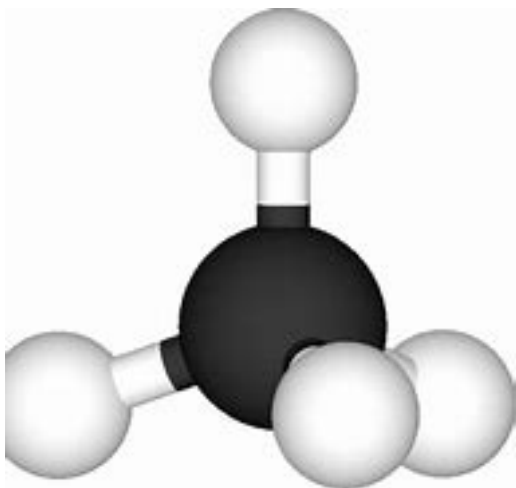


What color is a carbon atom?



Your response gives us a hint to your background.

- Chemist
- BLACK



- Biochemist
- GREY



Note this to your students if you use Moly-mods!



This model uses the CPK color scheme.

Carbon atoms: Grey

Oxygen atoms: Red

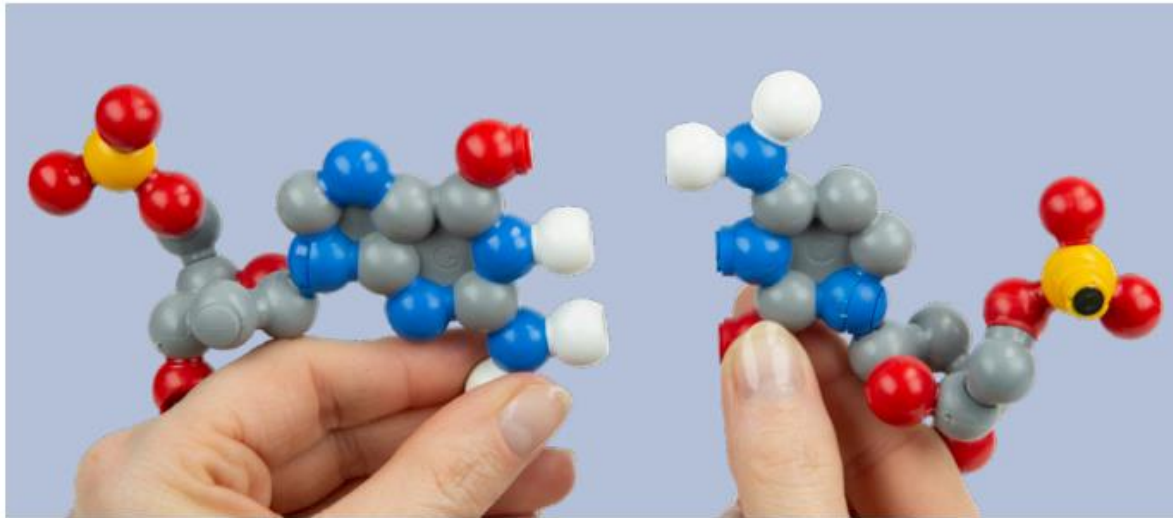
Nitrogen atoms: Blue

Phosphorus atoms: Orange

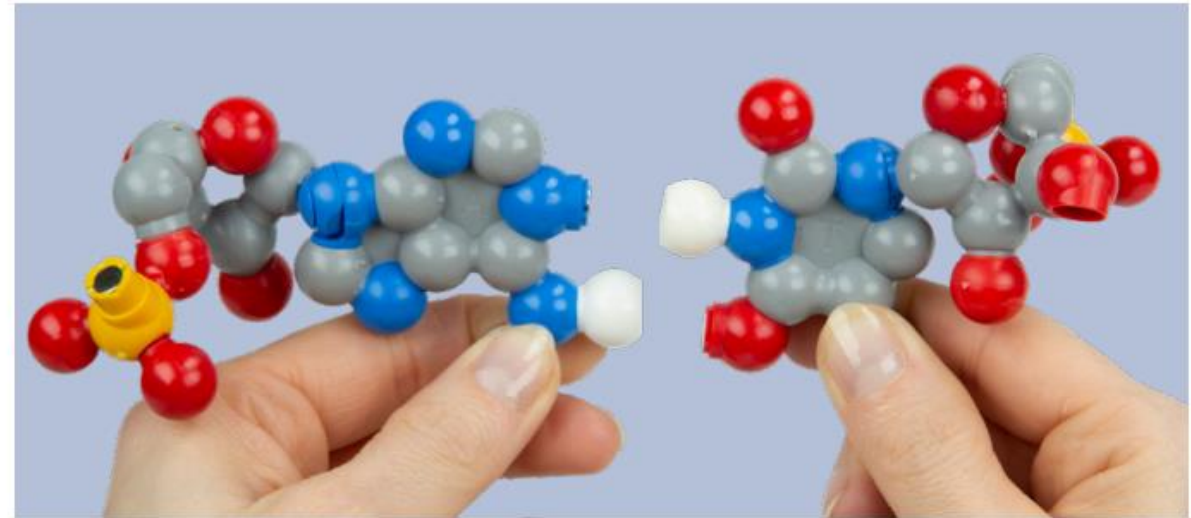
This color scheme became standardized because of the work by Corey, Pauling, and Koltun



Base pair with a complimentary nucleotide. A-T and C-G.



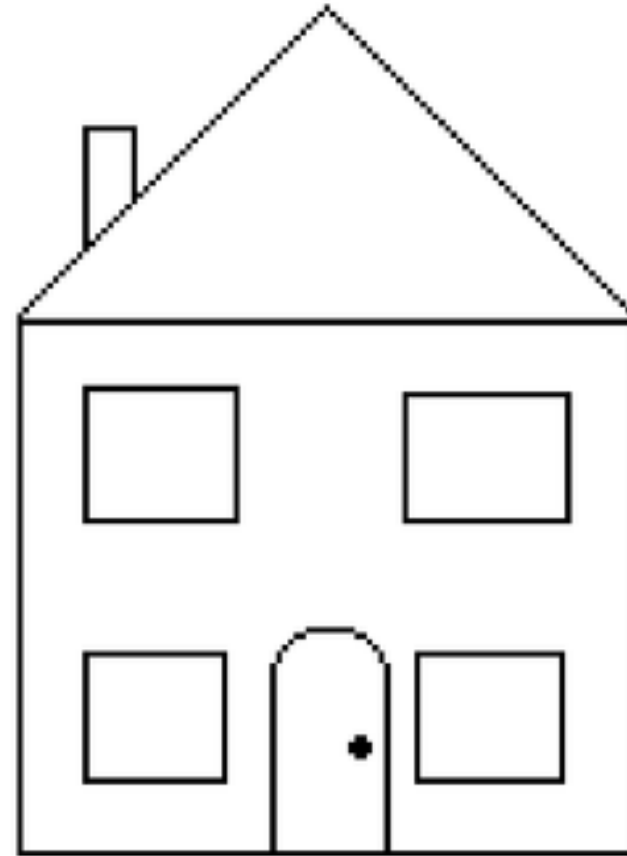
Three hydrogen bonds unite the G-C base pair.

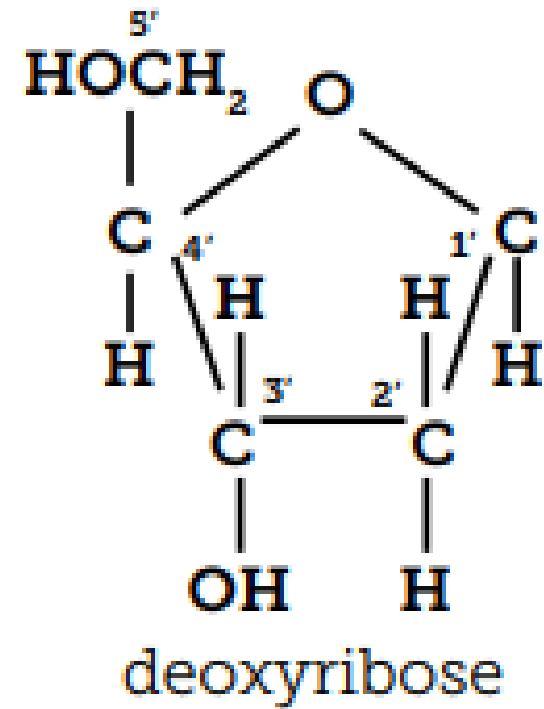


Two hydrogen bonds unite the A-T base pair.

* Notice the difference in the number of hydrogen bonds created.

How is Deoxyribose
like a house?





These are 2 different models of deoxyribose.

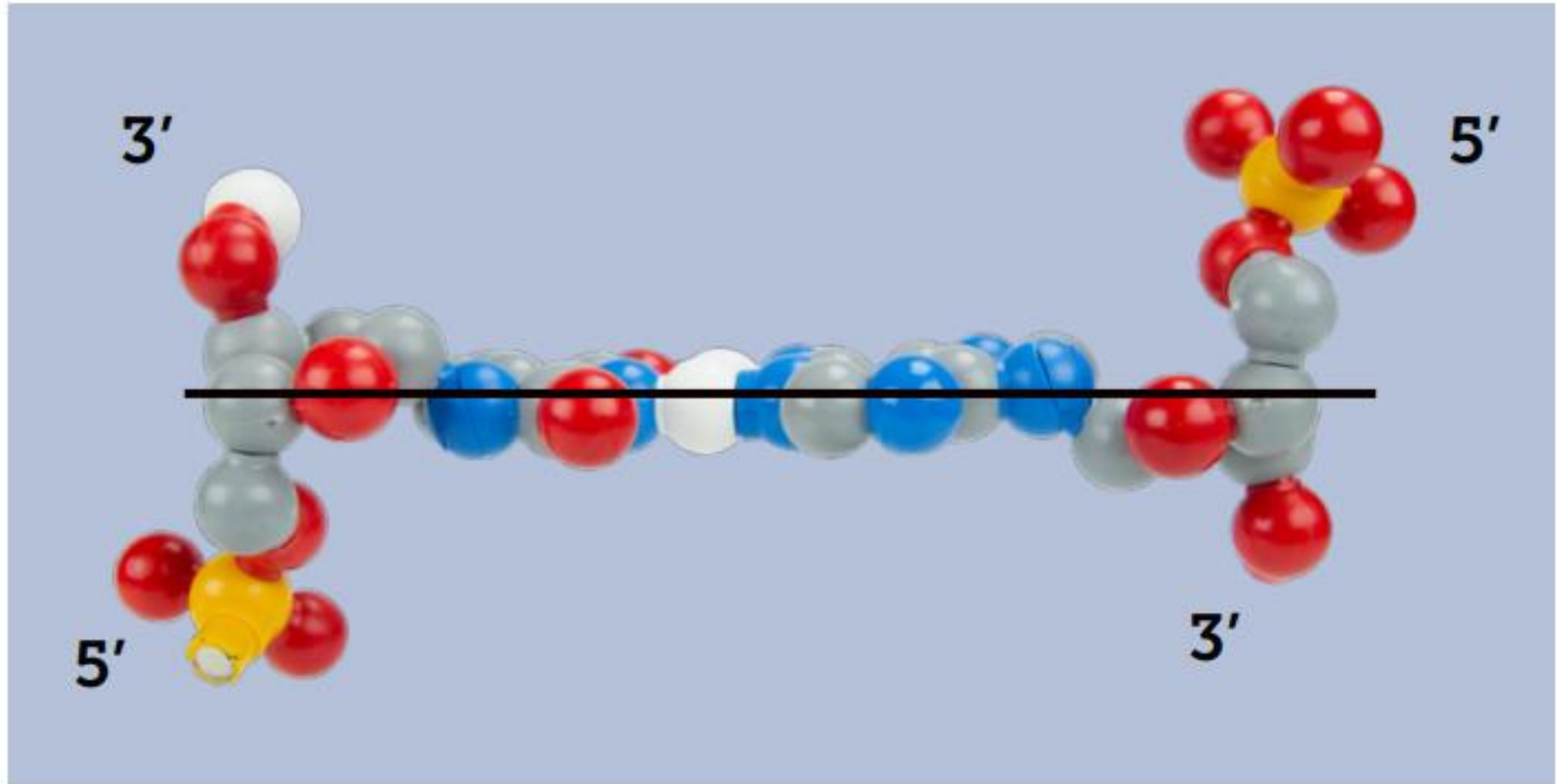
How are they similar?

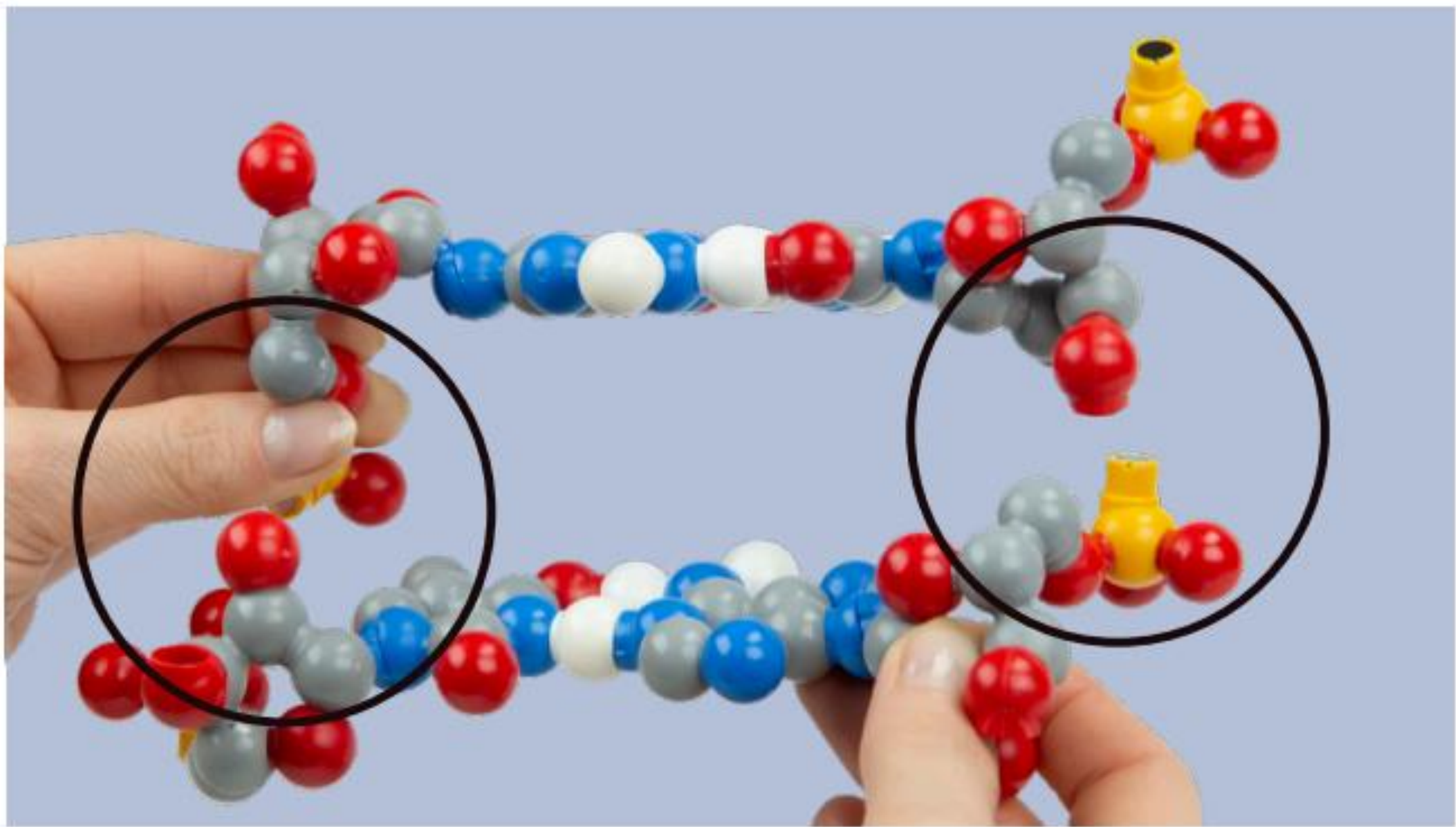
What makes them different?

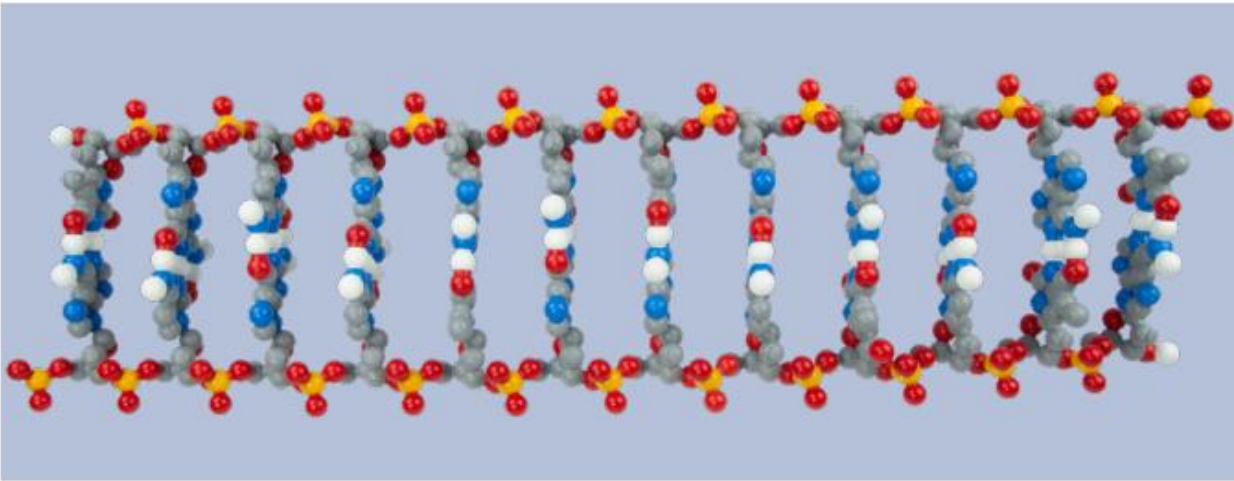
Which one is “better”?



DNA is anti-parallel







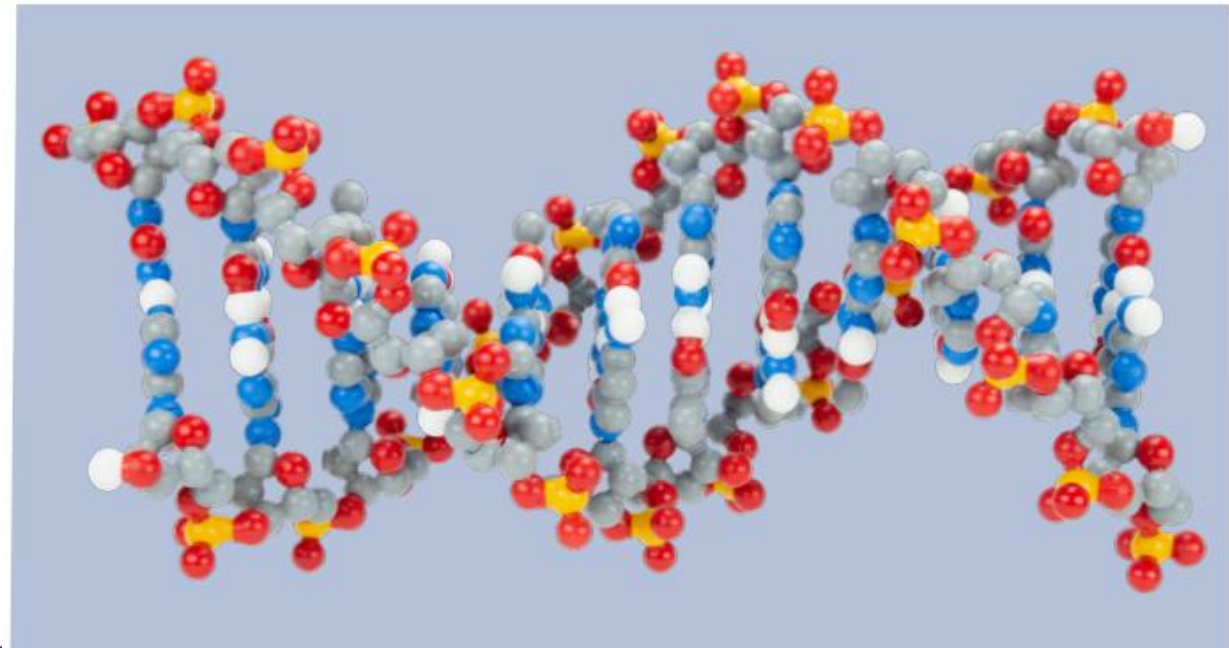
Linear format-

Replication / Transcription
Directionality

What else could you teach with this model?

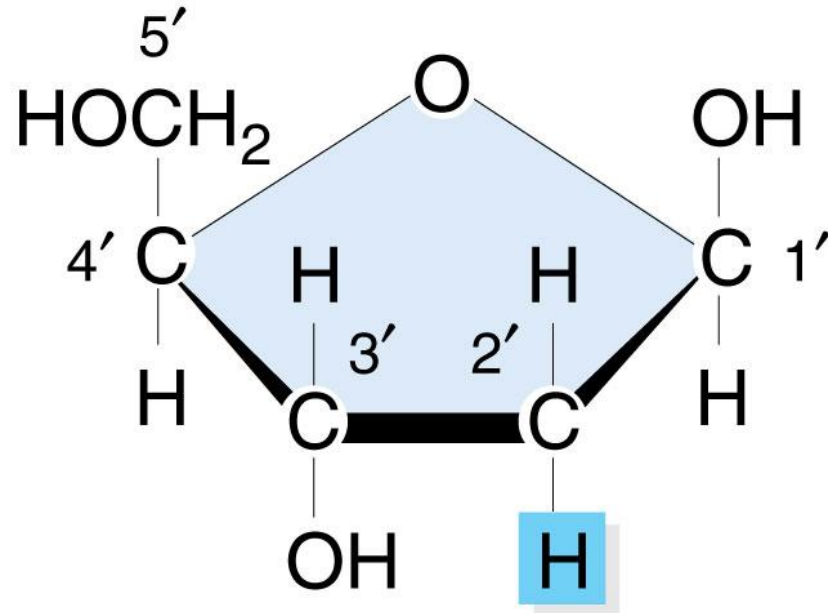
Double helix-

Right-handed helix
Major / minor groove
DNA Methylation

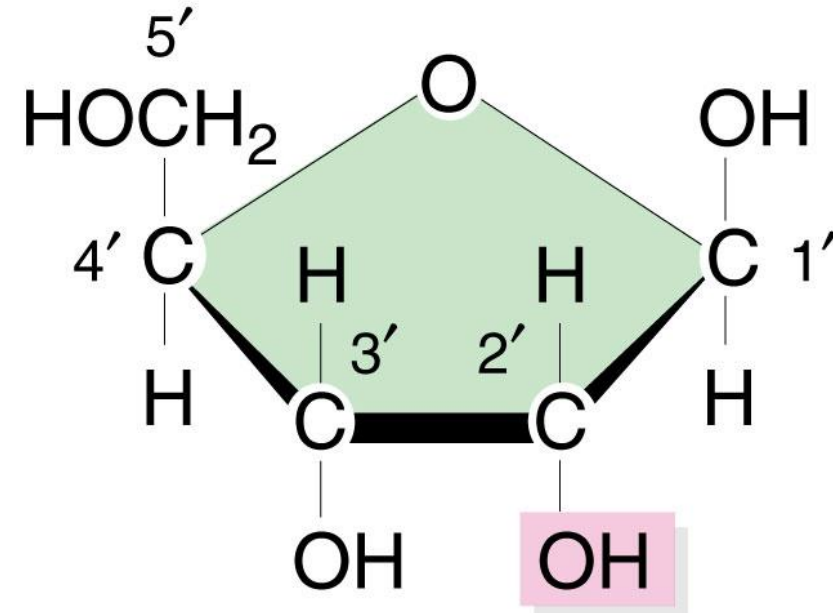


What is the difference between
Deoxyribose and Ribose?





Deoxyribose

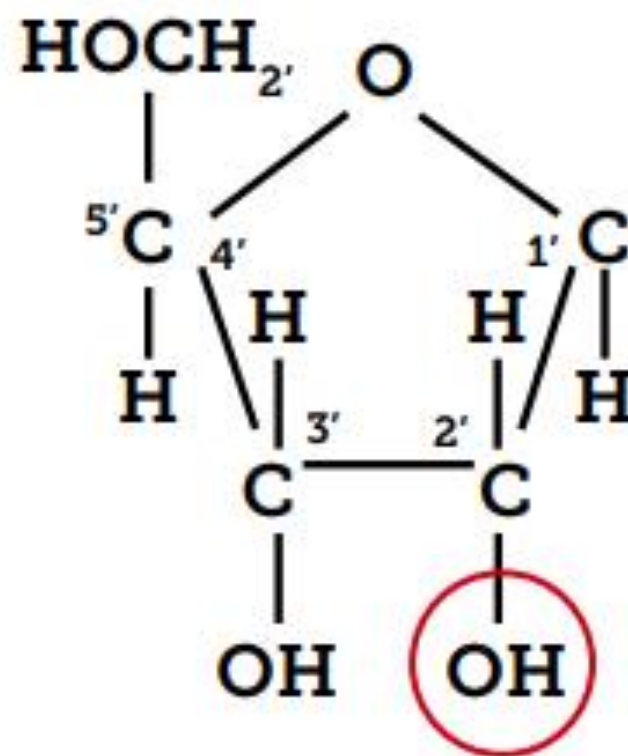


Ribose

© 2010 Pearson Education, Inc.

How can we model this for students?





ribose

Add on Oxygen to the 2'C and you have Ribose!



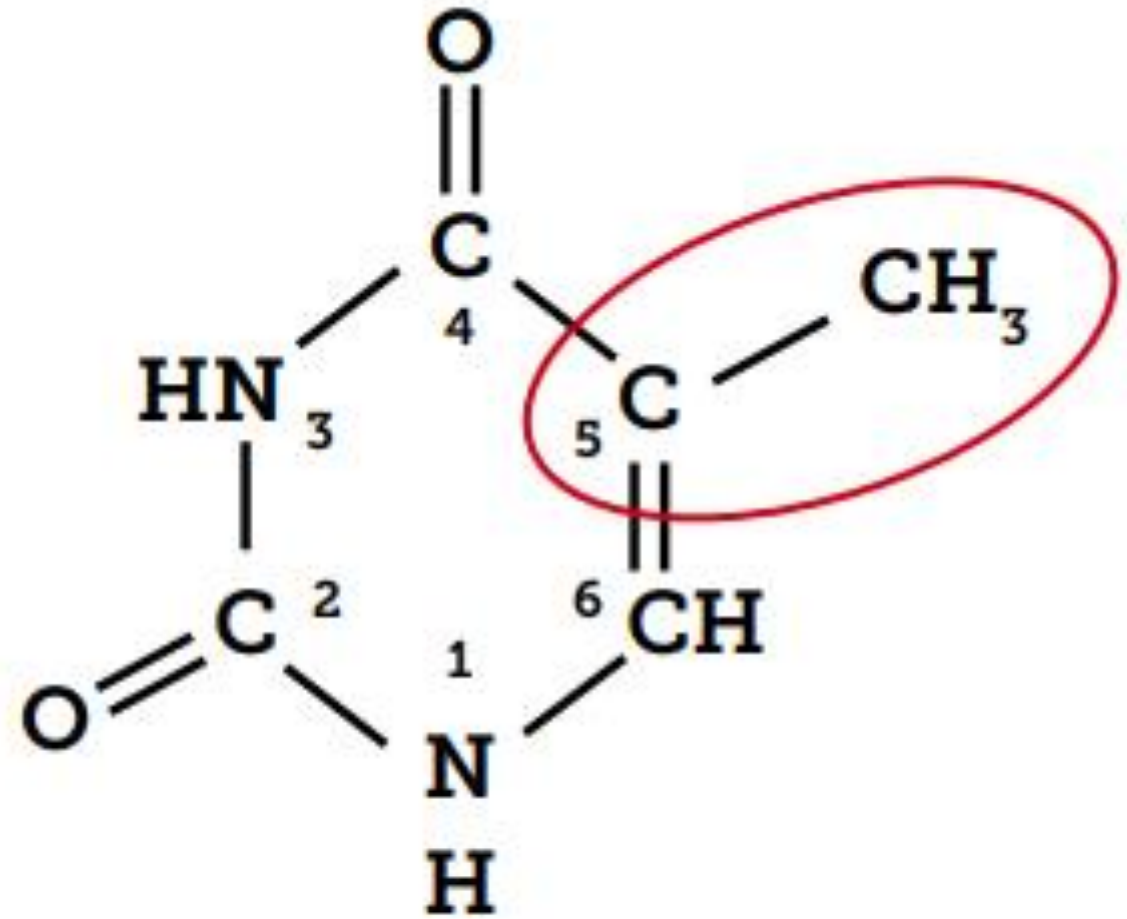
Where's the Hydrogen?



What are we still missing to model RNA?

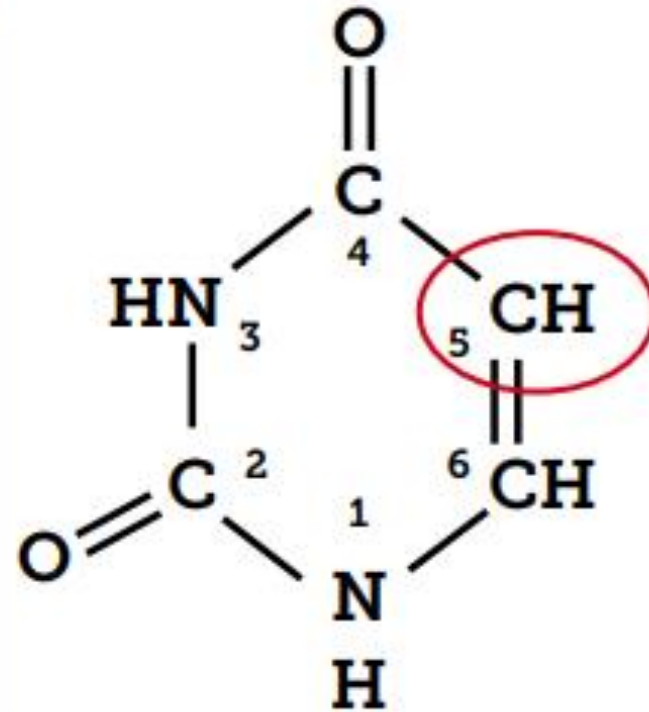
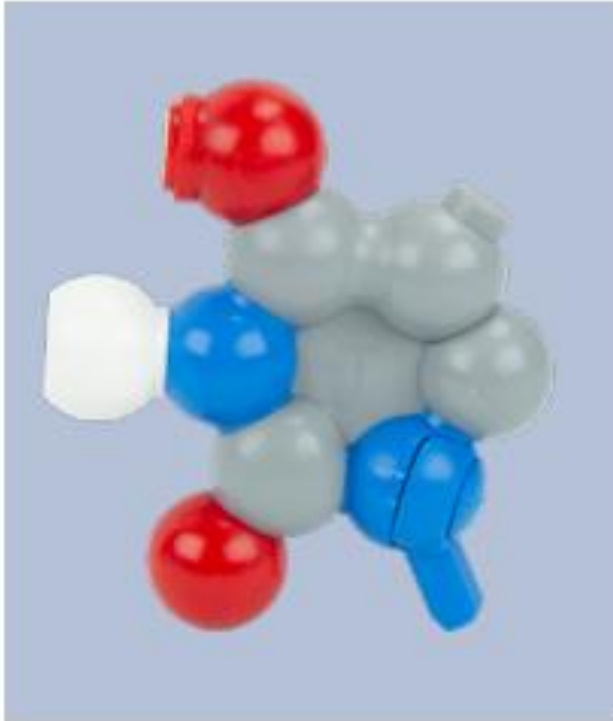
- How can we make it?





thymine (T)

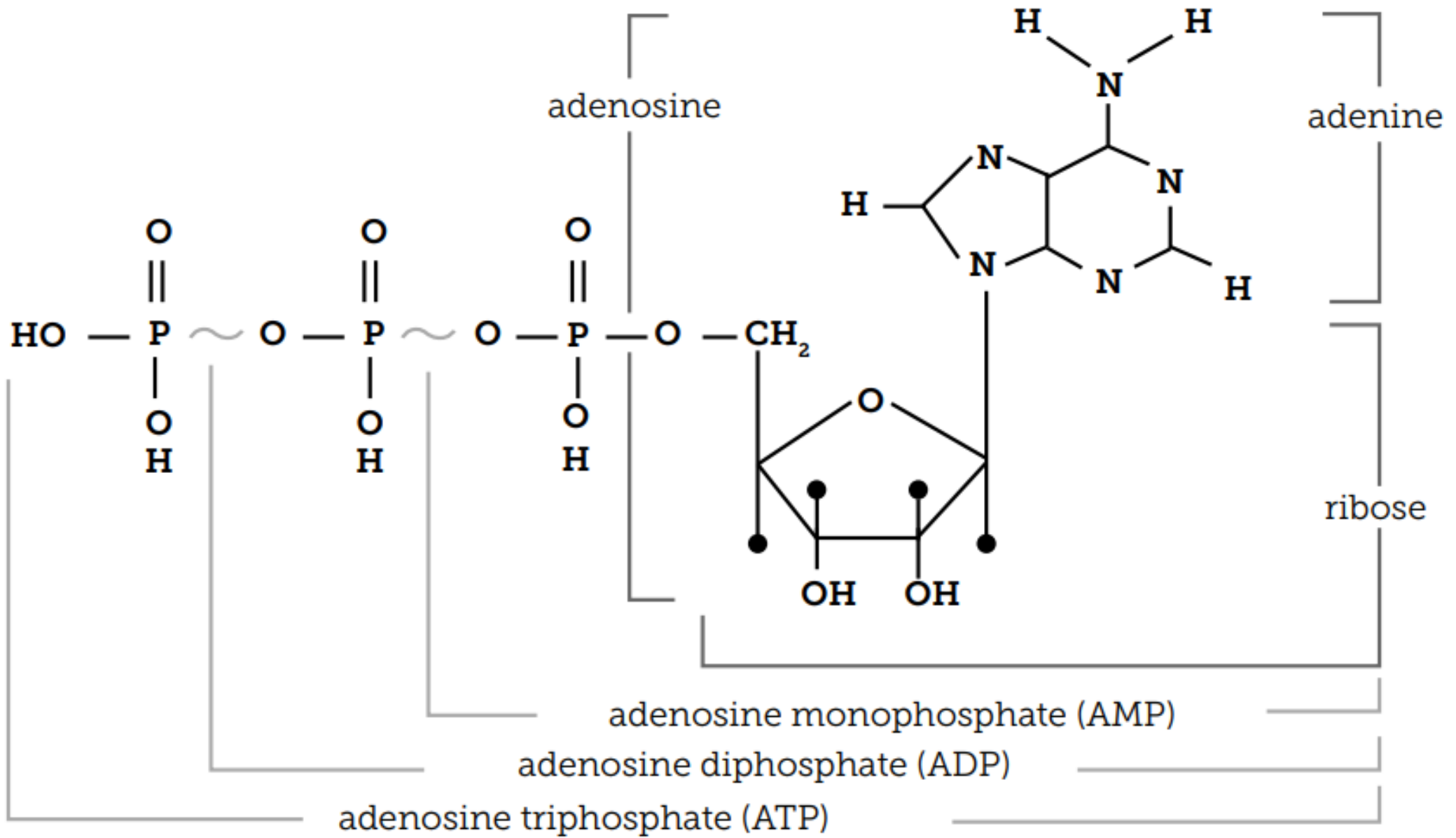




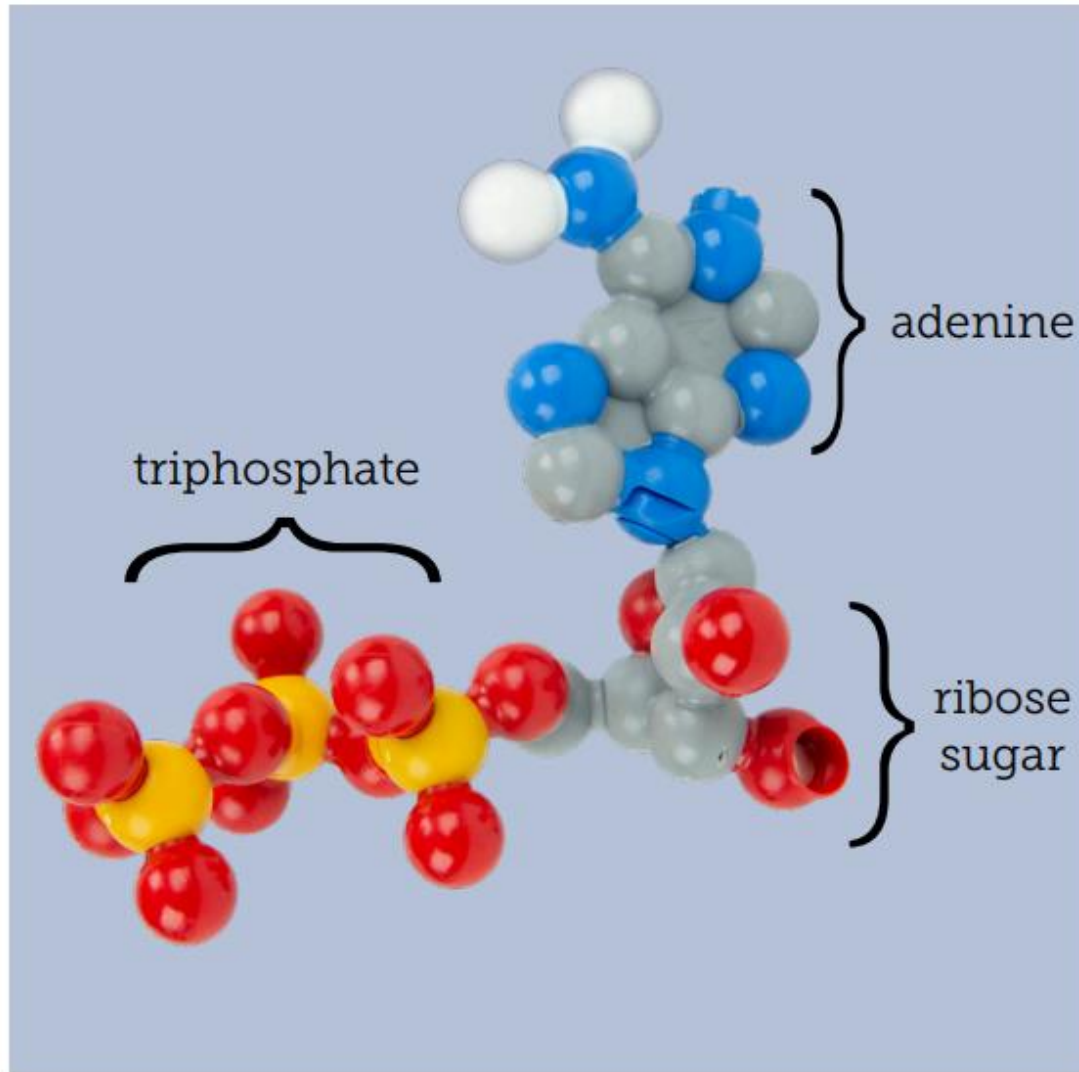
uracil (U)

- Remove a methyl group from the 5C of Thymine!





ATP & GTP



- 1) Find an adenine or guanine nucleotide
 - 2) Add 2 phosphate groups
 - 3) Add an Oxygen to the terminal Phosphorus
- You can also remove phosphate groups to make ADP, GDP, GMP, and AMP.



Resources and acknowledgements

- Additional reading:
- [Watson and Crick 1952](#)
- [Watson and Crick 1953](#)
- [DNA-Molecule of the month](#)
- Image Citations
- [Nucleotide](#)
- [Ribose vs Deoxyribose](#)
- [3D Molecular Designs](#)
- Teacher resources
- [Dynamic DNA – Teacher Guide](#)
- [Dynamic DNA – Replication](#)
- [Dynamic DNA - Transcription](#)





Workshop NGSS Connections

SEPs	CCCs	DCIs
Asking Questions and Defining Problems (HS-LS3-1)	Cause and Effect (HS-LS3-2)	Structure and Function (HS-LS1-1)
Developing and Using Models (HS-LS1-4)	Scale Proportion, and Quantity (HS-LS3-3)	
Analyzing and Interpreting Data (HS-LS3-3)	Systems and System Models (HS-LS3-3)	
	Science is a Human Endeavor (HS-LS3-3)	



We put teachers first!

Your opinions are important to us.

**We will email you
the resources associated
with this session.**





THANK YOU FOR ATTENDING!

Kits and models used in this session:



Dynamic DNA Kit



- Purchase kits at 3dmoleculardesigns.com.
- Use discount code **STATE22** to receive 20% off most items in our catalog.
- *Student Modeling Packs are not eligible for discount.*



