# DNA Structure

Atomic structure of DNA,
by Madeleine Price Ball (Wikimedia Commons)
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Topic Objectives

Task	Bloom's Level	BIOL 102 SLO	SOAP SLO	Core Concept	Core Competency
Arrange nucleotides by chemical structure and hydrogen-bonding capability	1	1a	A1, D2, E1, F2	Structure/function	Modeling, interdisciplinary nature of science
Apply knowledge of the chemical structure of nucleotides to explain DNA polarity notation	3	1a	A1, D2, E1, F2	Information flow/ storage	Modeling, interdisciplinary nature of science
Predict the impact of changing temperature on DNA structure	4	1a	A1, A2, C1, C1, D2, E1, F2, G1	Structure/function	Modeling, interdisciplinary nature of science

A Genetics Class Trailer

https://youtu.be/nzdLeJ5PLLM
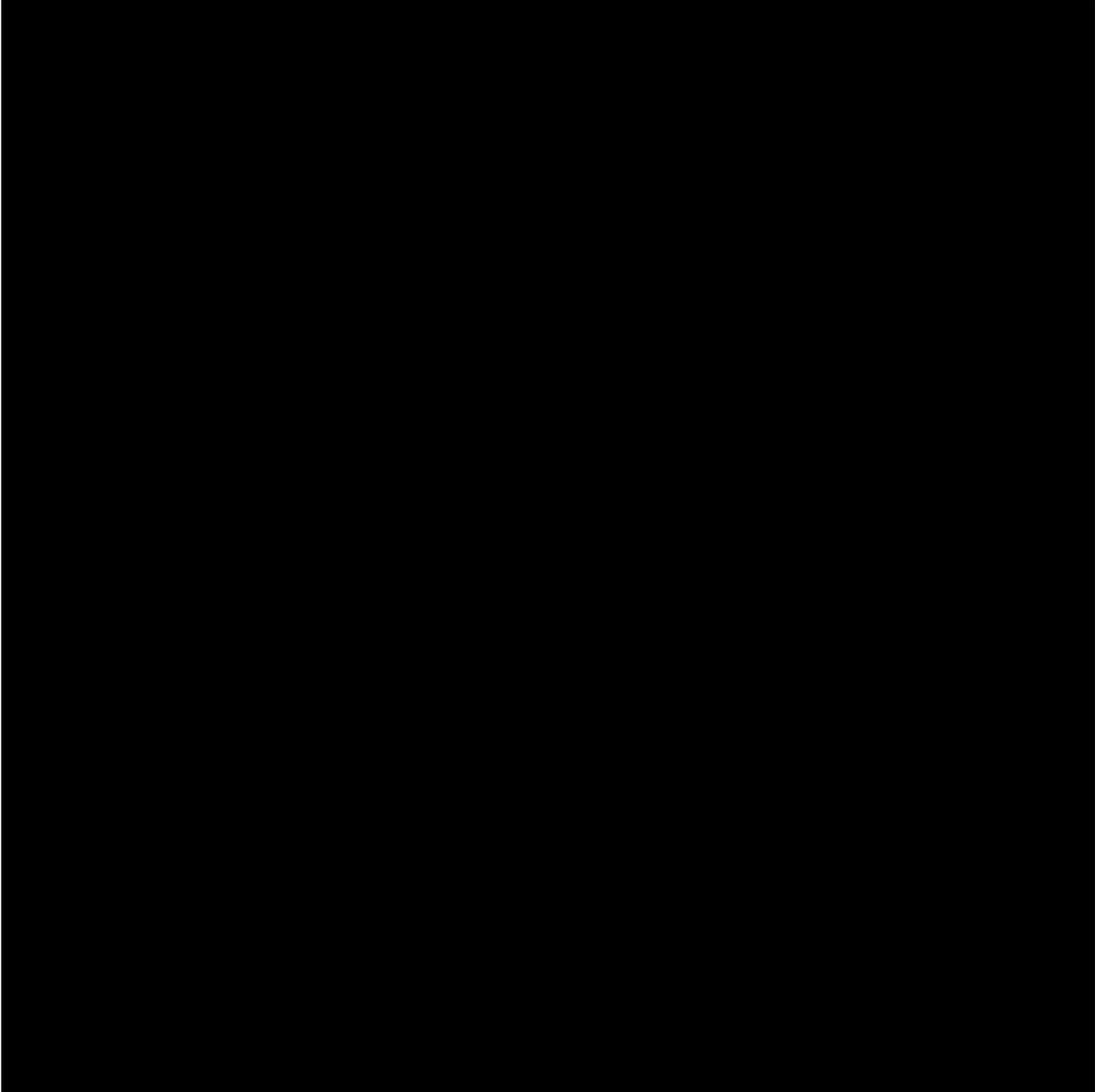
Deoxyribonucleic acid (DNA) is the primary molecule studied in genetics

DNA is a chemical that exists in discrete units (nucleotides). In living organisms, there are predominantly four distinct, but closely related, chemical structures that define those nucleotides: adenine, guanine, cytosine, and thymine. The main reason that such emphasis is placed on the understanding of the structure of DNA, especially of those four building blocks (A, G, C, and T) is that, like in this manual, the order of nucleotides in DNA encodes information. What you're reading now only makes sense because the 26 letters of our alphabet are being displayed to you in a sequence; that sequence grants meaning. This is one reason why we begin with learning about the nucleotides, how they are connected to each other at the atomic level, and how this arrangement gives us (and our cells) a way to tell which direction to read the nucleotide sequence.

Textbook Readings

Concepts 9.1 (The Structure of DNA)

Biology 3.5 (Nucleic Acids)
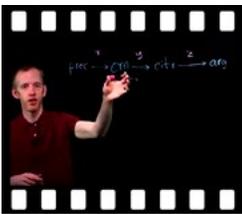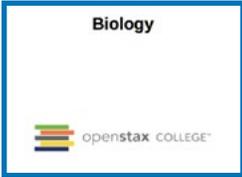
Microlectures 🔗

Nucleotides and polarity (4:22)

Basic Google Sheets (2:31)

Google Sheets average sum autofill (4:42)

Case Study Literature

Chargaff, Lipshitz and Green (1951) "Composition of the desoxypentose nucleic acids of four genera of sea-urchin." *J Biol Chem* **195**:155-160. *Focus on page 159: Table III. Your goals are to be able to discuss these questions: 1) What do the four columns of data represent? 2) What do the first five rows of data represent? 3) What patterns in the data did Chargaff and his colleagues discover?*

Schwartz (2008). "The importance of stupidity in scientific research." *J Cell Sci* **121**:1771.

(*PDFs of these two manuscripts are vailable on the course Canvas website*)

Vocabulary

ribose

deoxyribose

phosphate

double helix

strand

nucleotide

nitrogenous base

base pair

hydrogen bonding

polarity

melt/denature

purine

pyrimidine

What not to focus on

Memorizing chemical structures

Place your focus on

Knowing how the four nuleotides differ

Explaining how chemical atomic notation results in strand polarity

The relationships between hydrogen-bonding, Chargaff's Rule, the double-stranded nature of DNA, and the influence of temperature on DNA structure

Exercises

1.1 Labeling DNA

Label:
Ribose sugar
Phosphate
Backbone
Nitrogenous base
Base pair
Nucleotide
Strands (and their polarities)
Locations of hydrogen bonds
Purines
Pyrimidines
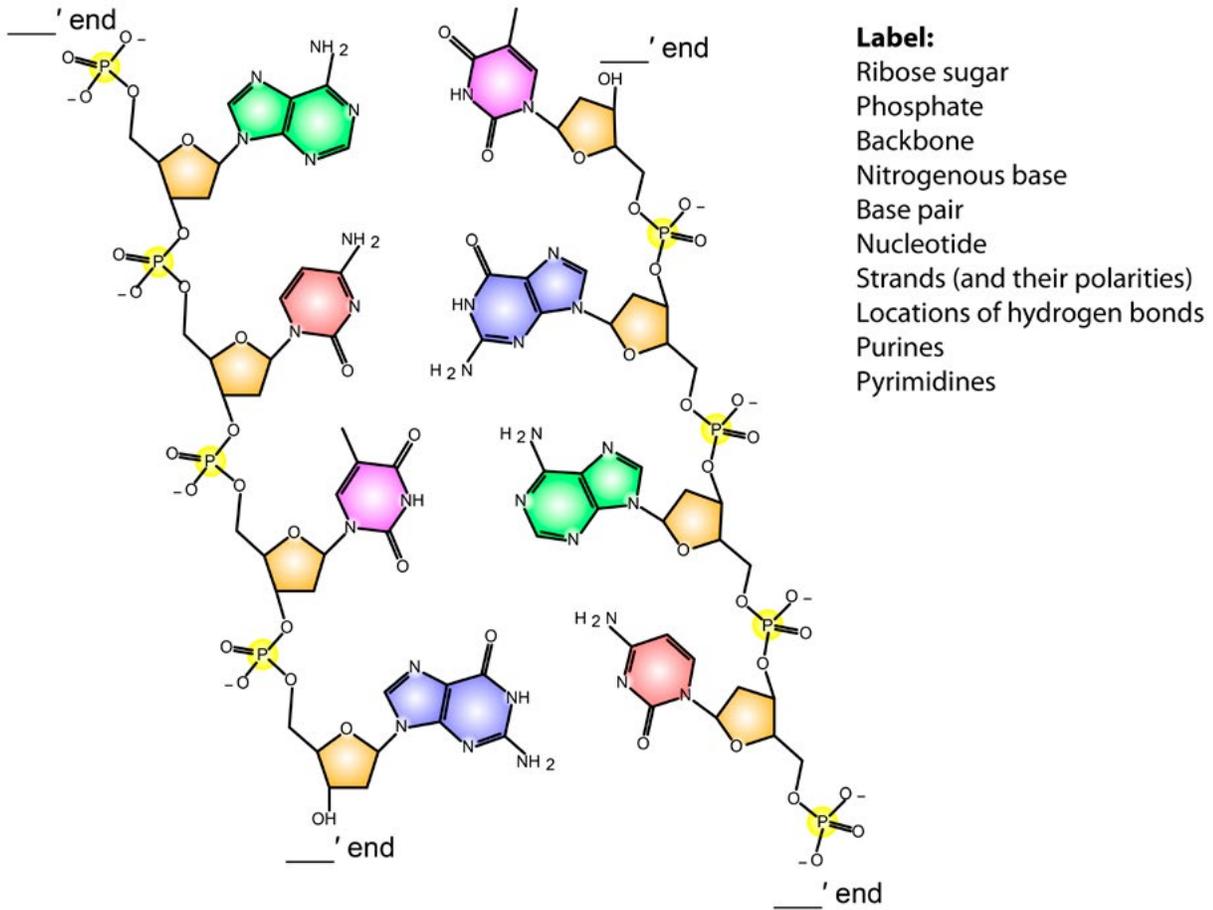
1.2 *Favoritus organismus*

Invent and write twenty base pairs of chromosome nucleotide sequence from a mythical species ("Your favorite organism") *Favoritus organismus*:

1.3 Analysis of Chargaff's Data

https://docs.google.com/spreadsheets/d/1B-JPmEsMKyTjc_3G36fbOJQUKURFaHcJr-dIVbLgLyxs/copy

Follow the instructions in the Google Sheet linked above. When you access this document, you will be asked if you would like to make a copy of it. Please make a copy and save it in your own Google Drive before working on the assignment.

1.4 Develop a model that explains Chargaff's data

Write or draw a definition and/or explanation for Chargaff's Rule:

F.A.I.L. Exercises for the Next Topic

Mindset
Spend no more than ten minutes working on this. Remember: as you read the question and as you attempt to answer, please write down all questions that arise in your mind and bring them to ask in class.

1.5 Restriction Endonucleases

Find and underline a restriction endonuclease recognition sequence in the following DNA sequence:

5'-GATCGACTACGACTCGAATTCGTCTACGGCTACTACGCAGAGGCCCGATCAGCATCAGCGATC-

GACTAGCAAAGGATCCAATCCGACTACATCTCAGAGCCGAC-3'

(Bonus if you can identify which restriction endonuclease identifies the sequence you underlined)