



BIOLOGY BY BRADFORD PRESENTS

BIO DECK

UNIT 1 • **CHEMISTRY OF LIFE**

“Collect all eight units.”

Definition cards

38 × BIO DECK

Application cards

24 × THE DAILY CELL

Layout

6 PER A4 PAGE

Printing

DOUBLE-SIDED • FLIP ON LONG EDGE

Assembly

CUT ALONG DASHED LINES

BIO DECK

U1 · AP-1.1



Small, repeating chemical subunits that serve as building blocks?

“Alone I am small. Together we are starch.”

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U1 · AP-1.2



Long molecules consisting of many similar building blocks linked by covalent bonds?

“We are legion. We are starch, protein, DNA.”

BIO DECK

U1 · AP-1.3



Chemical reaction that bonds monomers together by losing a water molecule?

“Lose water, make bonds.”

BIO DECK

U1 · AP-1.4



Chemical reaction that breaks bonds between monomers by adding water?

“Just add water. Watch everything fall apart.”

BIO DECK

U1 · AP-1.5



The amount of heat required to change the temperature of a substance?

“How much heat to move the needle?”

BIO DECK

U1 · AP-1.6



Water's ability to absorb/release high amounts of heat with little temp change?

“The ocean barely notices your heatwave.”

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AP-1.2

POLYMERS

Many monomers, covalently chained together.

Made of

MONOMERS

Linked by

COVALENT BONDS

Broken by

HYDROLYSIS

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AP-1.1

MONOMERS

The building blocks — link them to build polymers.

Builds

POLYMERS

Joined by

DEHYD. SYNTHESIS

Bond formed

COVALENT

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AP-1.4

HYDROLYSIS

Water in, bond broken — the reverse of dehydration synthesis.

Type

CATABOLIC

Water

ADDED

Reverse of

DEHYD. SYNTHESIS

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AP-1.3

DEHYDRATION SYNTHESIS

Monomer + monomer → covalent bond, one water out.

Type

ANABOLIC

Water

REMOVED

Reverse of

HYDROLYSIS

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AP-1.6

HIGH SPECIFIC HEAT

Water soaks up or sheds lots of heat with little temperature change.

Property of

WATER

Caused by

H-BONDS

Effect

STABLE TEMPS

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AP-1.5

SPECIFIC HEAT

How much heat it takes to move a substance's temperature.

Measures

HEAT PER °C

Water's rating

UNUSUALLY HIGH

Because of

H-BONDS

BIO DECK

U1 · AP-1.7



The cooling effect on a surface when liquid evaporates?

“The hottest molecules always leave first.”

BIO DECK

U1 · AP-1.8



Monomer of nucleic acids?

“Three parts. One letter of code.”

BIO DECK

U1 · AP-1.9



Molecules containing carbon, which serves as the “backbone” of life?

“Carbon-based, like everyone you know.”

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U1 · AP-1.10



The two polysaccharides that make up starch?

“Starch is a duo act.”

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U1 · AP-1.11



Elemental composition of carbs, lipids, proteins and nucleic acids?

“Four recipes, six elements.”

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U1 · AP-1.12



The result of H-bonds holding molecules at “arm's length” as water freezes?

“Water's weirdest party trick.”

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AP-1.8

NUCLEOTIDE

The monomer of DNA and RNA.

Parts

SUGAR+PHOSPHATE+BASE

Builds

DNA · RNA

Added at

3' END

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AP-1.7

EVAPORATIVE COOLING

A surface cools as its liquid evaporates away.

Escapees

HIGH-ENERGY MOLECULES

Result

SURFACE COOLS

Seen in

SWEATING

BIO DECK

AP-1.10

AMYLOSE + AMYLOPECTIN

Starch is a double act: one spiral, one branched.

Amylose

SPIRAL · LINEAR

Amylopectin

BRANCHED

Storage for

PLANTS

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AP-1.9

ORGANIC COMPOUNDS

Carbon-containing molecules — the chemistry of life.

Must contain

CARBON

Carbon bonds

4× COVALENT

Includes

ALL 4 MACROS

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AP-1.12

EXPANSION (LOWER DENSITY)

The H-bond lattice keeps freezing water at arm's length — ice takes up more room.

Cause

H-BOND LATTICE

Density

LOWER THAN LIQUID

So ice

FLOATS

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AP-1.11

CHO · CHO(P) · CHON(S) · CHONP

The element recipes — carbs, lipids, proteins, nucleic acids, in order.

Carbs

CHO

Proteins

CHON(S)

Nucleic acids

CHONP

BIO DECK

U1 · AP-1.13



**Ecological benefit of ice floating;
prevents ponds from freezing solid?**

“A lid for the lake.”

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U1 · AP-1.14



**Loss of protein shape (and function)
due to heat or pH changes?**

“Shape is everything. Was everything.”

BIO DECK

U1 · AP-1.15



**Elements found in all four types of
macromolecules?**

“The common denominator.”

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U1 · AP-1.16



**The “backbone” element that forms 4
covalent bonds?**

“Four hands. Infinite handshakes.”

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U1 · AP-1.17



**Monomer of carbohydrates (e.g.,
Glucose)?**

“Sweet and singular.”

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U1 · AP-1.18



Storage polysaccharide in plants?

“A potato’s retirement fund.”

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AP-1.14

DENATURATION

The interactions holding a protein's 3D shape break — and function goes with them.

Breaks

H-BONDS · R-GROUPS

Lost

SHAPE + FUNCTION

Triggers

HEAT · pH

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AP-1.13

SURFACE INSULATION

The floating ice layer blankets the water below.

Insulator

ICE LAYER

Protects

AQUATIC LIFE

Requires

ICE FLOATING

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AP-1.16

CARBON

Four covalent bonds make it the backbone of every organic compound.

Bonds

4× COVALENT

Role

BACKBONE

Found in

ALL 4 MACROS

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AP-1.15

CHO

Carbon, hydrogen, oxygen — the common denominator.

Found in

ALL 4 MACROS

+N appears in

PROTEINS · NUCLEIC

+P appears in

NUCLEIC · LIPIDS

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AP-1.18

STARCH

How plants bank their glucose.

Found in

PLANTS

Made of

AMYLOSE+AMYLOPECTIN

Animal rival

GLYCOGEN

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AP-1.17

MONOSACCHARIDE

A single sugar — the carbohydrate monomer.

Example

GLUCOSE

Ratio

C:H:O = 1:2:1

Builds

POLYSACCHARIDES

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U1 · AP-1.19



**Storage polysaccharide in animals
(stored in liver/muscles)?**

“The snack drawer of the animal kingdom.”

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U1 · AP-1.20



**Structural polysaccharide found in
plant cell walls?**

“You can chew me. You cannot beat me.”

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U1 · AP-1.21



**What determines the sequence of
amino acids?**

“The recipe behind every protein.”

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U1 · AP-1.22



**Property shared by all lipids (fats,
oils, waxes), which makes them repel
water?**

“It’s not you, water. Actually, it is.”

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U1 · AP-1.23



**Lipid with a hydrophilic head and two
hydrophobic tails?**

“Two-faced, and proud of it.”

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U1 · AP-1.24



Monomer of proteins?

“Twenty letters, infinite words.”

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AP-1.20

CELLULOSE

The structural polysaccharide of plant cell walls.

Role

STRUCTURE

Location

PLANT CELL WALLS

You digest it?

NO – FIBER

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AP-1.19

GLYCOGEN

Highly branched — more ends for enzymes, so glucose releases fast.

Found in

LIVER · MUSCLE

Structure

HIGHLY BRANCHED

Plant rival

STARCH

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AP-1.22

NONPOLAR / HYDROPHOBIC

The water-repelling property every lipid shares.

Shared by

FATS · OILS · WAXES

Polarity

NONE

With water

WON'T MIX

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AP-1.21

GENE

The DNA recipe behind every protein's amino-acid order.

Made of

DNA

Determines

PRIMARY STRUCTURE

One change

MUTATION

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AMINO ACID

The protein monomer — twenty kinds, one shared backbone.

Kinds

20

Variable part

R-GROUP

Linked by

PEPTIDE BONDS

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AP-1.23

PHOSPHOLIPID

One polar head, two nonpolar tails — amphipathic by design.

Head

POLAR

Tails

NONPOLAR × 2

Builds

MEMBRANE BILAYER

BIO DECK

U1 · AP-1.25



Bond that links amino acids together?

“Two amino acids walk into a ribosome...”

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U1 · AP-1.26



Level of protein structure determined by the sequence of amino acids?

“Get the order wrong, everything downstream suffers.”

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U1 · AP-1.27



Level of protein structure involving alpha-helices and beta-pleated sheets?

“Coils and pleats — very fashionable.”

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U1 · AP-1.28



Interaction where nonpolar R-groups cluster away from water?

“Introverts of the protein world.”

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U1 · AP-1.29



Overall 3D shape of a polypeptide due to R-group interactions?

“Where the folding gets personal.”

BIO DECK

U1 · AP-1.30



What does the R-group of an amino acid determine?

“It’s what’s on the side that counts.”

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AP-1.26

PRIMARY STRUCTURE

The amino-acid sequence itself — folding instructions for every later level.

Determined by

GENE

Weakness

MUTATION

Next level

SECONDARY (α/β)

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AP-1.25

PEPTIDE BOND

Carboxyl group of one amino acid meets the amino group of the next.

Type

COVALENT

Made by

DEHYD. SYNTHESIS

Builds

POLYPEPTIDES

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AP-1.28

HYDROPHOBIC INTERACTION

Nonpolar R-groups huddle together, away from water.

Drives

PROTEIN FOLDING

Location

INTERIOR CORE

Structure level

TERTIARY

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AP-1.27

SECONDARY STRUCTURE

Coils and pleats held together along the backbone.

Shapes

 α -HELIX · β -SHEET

Held by

H-BONDS (BACKBONE)

Next level

TERTIARY

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AP-1.30

PROTEIN FOLDING

The R-group decides how — and whether — a protein folds.

Decided by

R-GROUPS

Wrong fold

NO FUNCTION

R-groups vary across

20 AMINO ACIDS

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AP-1.29

TERTIARY STRUCTURE

The full 3D fold, set by R-group interactions.

Caused by

R-GROUP FORCES

Includes

HYDROPHOBIC · IONIC

Shape =

FUNCTION

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U1 · AP-1.31

?

Directionality of a DNA strand?*“We go together by going opposite ways.”*

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U1 · AP-1.33

?

Three components of a nucleotide?*“A trio with one job: information.”*

BIO DECK

U1 · AP-1.34

?

Bond that holds the two nitrogenous base pairs together?*“Weak alone. Unbeatable in billions.”*

BIO DECK

U1 · AP-1.35

?

The specific pairing rule for DNA: A with T (2 H-bonds) and G with C (3 H-bonds)?*“Everyone has a perfect match.”*

BIO DECK

U1 · AP-1.36

?

How many hydrogen bonds form between the different complementary base pairs?*“Count the bonds.”*

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U1 · AP-1.37

?

Compounds with the same molecular formula but different structures?*“Same ingredients, different dish.”*

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AP-1.33

SUGAR + PHOSPHATE + BASE

The repeating trio of every nucleotide.

Backbone

SUGAR + PHOSPHATE

Code carrier

NITROGENOUS BASE

Builds

DNA · RNA

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AP-1.31

ANTIPARALLEL (5' → 3')

The two strands run in opposite directions.

Strands

OPPOSITE WAYS

New bases add at

3' END

Enables

BASE PAIRING

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AP-1.35

COMPLEMENTARY BASE PAIRING

A with T, G with C — every single time.

A-T

2 H-BONDS

G-C

3 H-BONDS

Enables

REPLICATION

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AP-1.34

HYDROGEN BOND

The weak bond holding base pairs together — strength in numbers.

Strength (alone)

WEAK

A-T

2 BONDS

G-C

3 BONDS

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AP-1.37

ISOMERS

Same formula, different arrangement — different properties.

Formula

IDENTICAL

Structure

DIFFERENT

Example

GLUCOSE · FRUCTOSE

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AP-1.36

A-T: 2 · G-C: 3

The hydrogen-bond count for each base pair.

A-T

2 BONDS

G-C

3 BONDS

More GC →

MORE STABLE

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Metabolic reactions that **BUILD**
complex molecules using dehydration
synthesis?

“Under construction.”

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U1 · AP-1.39



Metabolic reactions that **BREAK**
DOWN complex molecules using
hydrolysis?

“Demolition crew.”

BIO DECK AP-1.39 CATABOLISM Metabolism’s demolition crew — breaking complexity down. Direction Uses Opposite BREAKS DOWN HYDROLYSIS ANABOLISM	BIO DECK AP-1.38 ANABOLISM Metabolism’s construction crew — building complexity. Direction Uses Opposite BUILDS DEHYD. SYNTHESIS CATABOLISM
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THE DAILY CELL U1 · AP-1.40  BODY HEAT · EXCLUSIVE WHY DOES <u>SWEATING</u> ACTUALLY COOL YOU DOWN?	THE DAILY CELL U1 · AP-1.41  CLIMATE FILES WHY DO <u>COASTAL CITIES</u> HAVE Milder climates than inland?
THE DAILY CELL U1 · AP-1.42  GRAVITY DEFIED HOW DO <u>TALL TREES</u> GET WATER TO THEIR LEAVES?	THE DAILY CELL U1 · AP-1.43  WINTER SURVIVAL WHY IS IT AN ADVANTAGE FOR AQUATIC LIFE THAT <u>ICE FLOATS</u>?
THE DAILY CELL U1 · AP-1.44  SNACK SCIENCE HOW DOES <u>GLYCOGEN'S STRUCTURE</u> ALLOW RAPID ENERGY RELEASE?	THE DAILY CELL U1 · AP-1.45  COLD CASE WHY DO <u>ARCTIC FISH</u> HAVE MORE UNSATURATED FATS IN THEIR MEMBRANES?

THE DAILY CELL

AP-1.41

THE ANSWER IS...

HIGH SPECIFIC HEAT

Water **absorbs heat by day and releases it at night** — the ocean is a giant storage heater next door.

THE SEA = A RADIATOR

THE DAILY CELL

AP-1.40

THE ANSWER IS...

EVAPORATIVE COOLING

The **highest-energy molecules** escape as gas — taking the heat with them and lowering the surface temperature.

TRAITORS TAKE THE HEAT

THE DAILY CELL

AP-1.43

THE ANSWER IS...

SURFACE INSULATION

The floating ice layer **stops the water below from freezing solid** — life carries on underneath.

A LID FOR THE LAKE

THE DAILY CELL

AP-1.42

THE ANSWER IS...

CAPILLARY ACTION

Cohesion (water sticks to water) plus **adhesion** (water sticks to xylem walls) haul water upward.

TEAMWORK ↑↑

THE DAILY CELL

AP-1.45

THE ANSWER IS...

FLUIDITY

Kinks in unsaturated tails prevent tight packing — the membrane stays liquid in the cold.

KINKS KEEP IT MOVING

THE DAILY CELL

AP-1.44

THE ANSWER IS...

HIGHLY BRANCHED

More branches means **more terminal ends** for enzymes to attack — glucose comes off quickly.

MORE ENDS = FASTER SNACKS

THE DAILY CELL

U1 · AP-1.46



KITCHEN CHEMISTRY

**WHY DOES HIGH HEAT
STOP AN ENZYME FROM
WORKING?**

THE DAILY CELL

U1 · AP-1.47



DNA SHOWDOWN

**HARDER TO PULL APART:
AT-RICH OR GC-RICH DNA?**

THE DAILY CELL

U1 · AP-1.48



HIDE & SEEK

**WHERE DO HYDROPHOBIC
AMINO ACIDS SIT IN A
FOLDED PROTEIN?**

THE DAILY CELL

U1 · AP-1.49



DOMINO EFFECT

**A MUTATION CHANGES ONE
AMINO ACID — WHICH
STRUCTURE LEVEL IS
AFFECTED?**

THE DAILY CELL

U1 · AP-1.52



RATE REPORT

**WHY DO BRANCHED
GLYCOGEN AND
AMYLOPECTIN HYDROLYSE
FASTER THAN LINEAR
STARCH?**

THE DAILY CELL

U1 · AP-1.54



ISOTOPE FILES

**LABELLING PHOSPHORUS
— WHICH TWO
MACROMOLECULES ARE
YOU TRACKING?**

THE DAILY CELL

AP-1.47

THE ANSWER IS...

GC-RICH

Three hydrogen bonds per G–C pair versus a measly two for A–T. More bonds, more energy to break.

COUNT THE BONDS!

THE DAILY CELL

AP-1.46

THE ANSWER IS...

DENATURATION

Heat breaks the H-bonds and R-group interactions — the 3D shape unravels and function goes with it.

SHAPE = FUNCTION!

THE DAILY CELL

AP-1.49

THE ANSWER IS...

ALL LEVELS

Primary structure changes directly — and can ruin folding at every level after it.

ONE TYPO, WHOLE BOOK RUINED

THE DAILY CELL

AP-1.48

THE ANSWER IS...

THE CORE

Nonpolar R-groups cluster in the interior, away from the surrounding water.

INTROVERTS ON THE INSIDE

THE DAILY CELL

AP-1.54

THE ANSWER IS...

NUCLEIC ACIDS + PHOSPHOLIPIDS

P sits in the sugar-phosphate backbone and in phospholipid heads.

FOLLOW THE P

THE DAILY CELL

AP-1.52

THE ANSWER IS...

MORE ENDS

Every branch tip is another place an enzyme can start snipping glucose off.

ATTACK FROM ALL SIDES

THE DAILY CELL

U1 · AP-1.55



FROM THE LAB BENCH

**LABEL ONLY PROTEINS,
NOT DNA — WHICH
RADIOACTIVE ISOTOPE?**

THE DAILY CELL

U1 · AP-1.56



EXAM STRATEGY

**A PROCESS FAILS AFTER A
TEMPERATURE SPIKE —
MOST LIKELY MOLECULAR
REASON?**

THE DAILY CELL

U1 · AP-1.58



ARCHITECTURE DESK

**WHICH BOND MAINTAINS
SECONDARY STRUCTURE
(A-HELICES, B-SHEETS)?**

THE DAILY CELL

U1 · AP-1.59



ENERGY AUDIT

**WHICH NEEDS MORE
ENERGY TO SEPARATE:
60% GC OR 60% AT DNA?**

THE DAILY CELL

U1 · AP-1.60



STRUCTURAL REPORT

**WHY MUST DNA STRANDS
BE ANTIPARALLEL?**

THE DAILY CELL

U1 · AP-1.61



IDENTITY CHECK

**WHY ARE PHOSPHOLIPIDS
CALLED AMPHIPHATHIC?**

THE DAILY CELL

AP-1.56

THE ANSWER IS...

DENATURATION

Enzymes are proteins — heat wrecks their shape, and **shape is their function**.

SUSPECT THE ENZYMES FIRST

THE DAILY CELL

AP-1.55

THE ANSWER IS...

SULFUR-35

Sulfur is in proteins but not DNA — P-32 would light up nucleic acids instead.

S = PROTEIN'S SIGNATURE

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AP-1.59

THE ANSWER IS...

60% GC

Every G-C pair brings **three H-bonds to break** instead of two.

GC = SUPERGLUE

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AP-1.58

THE ANSWER IS...

HYDROGEN BONDS

Formed **between backbone atoms** — not the R-groups — holding the coils and pleats.

BACKBONE BUSINESS ONLY

THE DAILY CELL

AP-1.61

THE ANSWER IS...

TWO NATURES

A **polar head** plus **nonpolar tails** in one molecule — hydrophilic and hydrophobic at once.

BEST OF BOTH WORLDS

THE DAILY CELL

AP-1.60

THE ANSWER IS...

BASE PAIRING

The opposite orientation **lines the bases up** for complementary hydrogen bonding.

OPPOSITES ATTRACT, LITERALLY

THE DAILY CELL

U1 · AP-1.62



INFORMATION BUREAU

WHICH PART OF DNA DOES
THE ACTUAL CODING?

THE DAILY CELL

U1 · AP-1.63



CONSTRUCTION UPDATE

NEW NUCLEOTIDES ARE
ADDED TO WHICH END
DURING DNA SYNTHESIS?

THE DAILY CELL

U1 · AP-1.64



BOND REPORT

WHICH COVALENT BOND
JOINS A CARBOXYL GROUP
TO AN AMINO GROUP?

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U1 · AP-1.66



CHAIN REACTION

HOW CAN A PRIMARY
STRUCTURE CHANGE
DISRUPT QUATERNARY
STRUCTURE?

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U1 · AP-1.67



FORENSICS

A MACROMOLECULE HAS
C:H:O OF 1:2:1 — WHICH
CATEGORY?

THE DAILY CELL

U1 · AP-1.68



COLD ENGINEERING

HOW DO UNSATURATED
FATTY ACIDS KEEP
MEMBRANES FLUID IN
COLD?

THE DAILY CELL

AP-1.63

THE ANSWER IS...

3' HYDROXYL

Growth happens only at the **3' -OH group** — synthesis runs 5' → 3', always.

BUILD AT THE 3'!

THE DAILY CELL

AP-1.62

THE ANSWER IS...

THE BASE SEQUENCE

The **linear order of base pairs** is what carries the biological information.

IT'S THE ORDER THAT TALKS

THE DAILY CELL

AP-1.66

THE ANSWER IS...

FOLDING CASCADE

The sequence is the **folding instructions** — change it and every later level can misfold.

ONE CHANGE ECHOES UPWARD

THE DAILY CELL

AP-1.64

THE ANSWER IS...

PEPTIDE BOND

Formed by **dehydration synthesis** — chaining amino acids into polypeptides.

THE PROTEIN HANDSHAKE

THE DAILY CELL

AP-1.68

THE ANSWER IS...

KINKS

Double-bond kinks **stop the tails packing tightly** — the membrane never freezes solid.

BENT TAILS DON'T STACK

THE DAILY CELL

AP-1.67

THE ANSWER IS...

CARBOHYDRATE

That ratio is the **monosaccharide fingerprint** — think $C_6H_{12}O_6$.

1:2:1 = SUGAR'S ID