

This record is presented in recognition of contributions to Eterna, the internet-scale molecular design platform.
Verify authenticity of this record at: <https://eternagame.org/certificate/51350>

ISSUED**May 19, 2025****PLAYER DETAILS**

PERSONAL NAME	Billy Reuben
PLAYER NAME	Billy Reuben
REGISTRATION DATE	September 2012
GLOBAL RANK	92 of 184,446
PUZZLES CLEARED	2,565
PUZZLES CREATED	10
TUTORIALS CLEARED	5/5
ADVANCED TUTORIALS CLEARED	9/10

Eterna puzzles are created by the Eterna team or players. They invite players to devise effective procedures for pairing nucleotides in hypothetical or biologically-inspired RNA strands.

Learn more on Billy Reuben's player profile: <https://eternagame.org/players/51350>

PUBLICATION CONTRIBUTIONS

Contributions towards pre-print or peer-reviewed scientific publications.

1. EVIDENCE OF AN UNUSUAL POLY(A) RNA SIGNATURE DETECTED BY HIGH-THROUGHPUT CHEMICAL MAPPING

May 2020 [Biochemistry](#) *Gameplay Contributor*

2. PRINCIPLES FOR PREDICTING RNA SECONDARY STRUCTURE DESIGN DIFFICULTY

February 2016 [Journal of Molecular Biology](#) *Gameplay Contributor*

3. ETERNABRAIN: AUTOMATED RNA DESIGN THROUGH MOVE SETS FROM AN INTERNET-SCALE RNA VIDEOGAME

June 2019 [PLOS Computational Biology](#) *Gameplay Contributor*

4. RNA SECONDARY STRUCTURE PACKAGES EVALUATED AND IMPROVED BY HIGH-THROUGHPUT EXPERIMENTS

October 2022 [Nature Methods](#) *Gameplay Contributor*

5. SENTRNA: IMPROVING COMPUTATIONAL RNA DESIGN BY INCORPORATING A PRIOR OF HUMAN DESIGN STRATEGIES

March 2018 [Preprint](#) *Gameplay Contributor*

6. THEORETICAL BASIS FOR STABILIZING MESSENGER RNA THROUGH SECONDARY STRUCTURE DESIGN

September 2021 [Nucleic Acids Research](#) *Gameplay Contributor*

7. CROWDSOURCED RNA DESIGN DISCOVERS DIVERSE, REVERSIBLE, EFFICIENT,

SELF-CONTAINED MOLECULAR SENSORS

April 2022 [Proceedings of the National Academy of Sciences](#) *Gameplay Contributor*

8. COMBINATORIAL OPTIMIZATION OF MRNA STRUCTURE, STABILITY, AND TRANSLATION FOR RNA-BASED THERAPEUTICS

March 2022 [Nature Communications](#) *Gameplay Contributor*

9. DEEP LEARNING MODELS FOR PREDICTING RNA DEGRADATION VIA DUAL CROWDSOURCING

December 2022 [Nature Machine Intelligence](#) *Gameplay Contributor*

10. COMMUNITY SCIENCE DESIGNED RIBOSOMES WITH BENEFICIAL PHENOTYPES

February 2023 [Nature Communications](#) *Gameplay Contributor*

DESIGN SUBMISSIONS

Contributions towards Eterna biomedical challenges experimentally tested through in-vitro synthesis and structure mapping measurements.

	TOTAL (#)	TESTED	BEST (%)
Classic Eterna	54	0	-
FMN aptamers	15	0	92
First Player Project	38	0	-
Switches	15	0	88
Cloud Lab 1 - Aires by wateronthemoon	4	4	86
Cloud Lab 2 - Triangle of doom version 2 by dstea	4	4	87
Cloud Lab 3 - A Simple Zigzag by janelle	4	3	81
Cloud Lab 4 - Random by theravin	4	3	83

Cloud Lab 5 - The Nonesuch by rnjensen45	4	4	91
Cloud Lab 6 - Cross by firedrake969	4	3	94
Cloud Lab 7 - 5 Fold Radial Asymmetrical Starfish Level 0 by Jieus	4	3	84
Cloud Lab 8 - Stellar Crossbow by jmf028	4	4	81
Cloud Lab 9 - Final Countdown by Tesla'sDisciple	4	3	88
Cloud Lab 10 - Random Shape 2 by ElNando888	4	3	88
Cloud Lab 11 - Little bug by JR	4	4	91
Cloud Lab 12 - Anchor by ribonucleic	4	4	83
Cloud Lab 13 - Alien Party Glasses by Jennifer Pearl	4	4	89
Cloud Lab 14 - Easy loop sizes by Edward Lane	4	3	86
Cloud Lab 15 - Triloop Buffet by jandersonlee	4	4	86
Cloud Lab 16 - Section from lab Water Strider by Brouard	4	4	94
Cloud Lab 17 - Oryza sativa 8 Elements Part 2 by merryskies	4	4	83
Cloud Lab 18 - Anaconda About to Poop by SpaceFolder	4	4	91
Cloud Lab 19 - Big Hairpin Loop by Eli Fisker	4	4	97
Cloud Lab 20 - Random 4 by mat747	4	4	91
LabPuz02 by JR	2	0	-
Bistable 3 by jnicol	3	0	98
Hair Trigger by space_miser	3	0	95
Will It Bind? by jmf028	3	0	45
Stratospheric by Dennis9600	3	1	76
My Screw-Up Corrected? by SpaceFolder	3	1	55
Chirality by kcabral28	1	0	-
Switch Test 1 by Brouard	1	0	-
Top Notch by jmf028	1	0	80
Ball & Chain by Krobar	3	0	-
Simplify by Tesla'sDisciple	3	0	-
An Arm and a Leg 1.0 by kcabral28	3	0	-

Huffman by hotcreek	3	1	73
QRNAL0 by Quxwozing	1	0	-
Riboswitch-based by jruaya	3	1	92
1-X bulge testing by Omei	3	0	-
EzFold by space_miser	3	1	93
Thursday by DHammond	3	0	-
TEBOWNED	9	0	96
The GAAA loop	3	1	77
Two stacks	3	0	-
RNA Bridge	3	1	75
Hex-a-Stripe	3	1	78
RNA Bridge (Updated)	3	0	-
Tribute To Satellite Kepler	3	1	98
Tighter Two Stacks for 3-way Multi-Loop testing	3	1	79
Short Stacks	3	1	95
2-2 and 3-3 loops	3	1	63
"Magic" boosts in 2-2 loops	3	0	-
Two Stacks - Triloop hairpin variation	3	0	-
Single state - Switch state	3	0	-
RNA Strength	1	0	-
Quad Loop test	3	1	62
Magic boosts in 2-2 loops revised, thanks starry	3	1	75
1-1-1-1-1 Multiloop	1	0	-
Single to Switch try #2	3	1	91
Variations on a theme of 1-0 loops and short stack hairpins	3	0	-
A-U Closing Base Pairs	3	0	-
A-U Closing Base Pairs 2	3	0	96
Tetraloops and 0-0-0-0 Multiloop Phase 1	3	3	97
Tetraloops and 0-0-0-0 Multiloop Phase 1 Version 2	3	3	85

Find Z - Here It Is!	3	1	86
Lonely Base Pair - 1-1: Multiloop	3	1	80
Lonely Base Pair - 2-2: Multiloop	3	1	90
Lonely Base Pair - 3-3: Multiloop	3	0	97
Can We do it in 10? - FMN Switch 2.0	3	0	98
Triloop with multiloop core phase 1	3	3	80
Two Bulge "Zigzag" - Both Conformations	3	0	94
Two Bulge "Zigzag" - Variation 1	3	0	93
Two Bulge "Zigzag" - Variation 2	3	0	93
Two Bulge "Zigzag" - Variation 3	3	0	94
Two Bulge "Zigzag" - Variation 4	3	0	81
G-U Closing Base Pairs	3	3	92
G-U Closing Base Pairs 2	3	3	93
Reversed G-C Multibranch Loop Closing Base Pairs	3	2	98
Short Stacks 2	3	1	97
Probing for tertiary structure	3	1	73
Modeled Impossible: 31+ Nucleotide Internal Loops	3	3	96
SARS coronavirus structure test	3	0	90
FMN Binding Site Chemical Footprint - Round 2	4	3	88
Modeled Impossible: 1 Nucleotide Bulge/Triloop Lonely base pair V1	3	2	77
Modeled Impossible: 1 Nucleotide Bulge/Triloop Lonely base pair V2	3	0	81
New Frontier	3	0	85
TinkerToy Retread	3	3	96
Frog leg - relaxed	3	3	88
Frog leg - Electric	3	3	90
Frog leg - Stretched toe	3	3	91
ZigZag and ZagZig	3	0	85

Chicken leg	3	0	93
Chicken leg - Splayed	3	0	93
Motor Protein - Step 1	3	3	82
Motor Protein - Step 2	3	0	88
Motor Protein - Step 3	3	1	80
Intersecting stacks investigation	3	0	89
Intersecting stacks 2	3	0	86
Is RNA directional 1 of 2	3	0	96
Is RNA directional 2 of 2	2	0	97
Intrinsically unfolded RNA	3	0	100
Probing the structure of poly-A loops by mutation	3	1	98
Semicircle - 2 bends	3	0	84
Semicircle - 3 bends	2	0	76
Semicircle - 4 bends	2	0	93
Semicircle - 5 bends	3	0	87
Location Dependent Chemical Footprints Part 1	3	3	91
Location Dependent Chemical Footprints Part 2	2	2	98
Location Dependent Chemical Footprints Part 3	3	3	91
Location Dependent Chemical Footprints Part 4	3	0	94
Location Dependent Chemical Footprints Part 5	3	0	88
Location Dependent Chemical Footprints Part 6	3	1	94
Could Curves Survive?	2	2	84
Adding some sweet tetraloops	2	2	98
Teeny tRNA	3	0	98
Palindromes part one	3	1	84
Dimer B	2	2	96
Dimer A	1	0	76
Improving the Nearest Neighbor Energy Model Using Eterna	3	0	-
Robot serial killer 1 - Lab killer too?	1	0	90

Robot serial killer 2 - Lab killer too?	1	0	88
Short Stacks 3	1	0	85
Ziggy 25 (aka Multiloop Test)	3	1	82
Test of locking loop bases in a ribozyme-like structure	3	0	82
Relaxed multiloop 1	3	0	98
Relaxed multiloop 2	1	0	93
New Frontier 2	1	0	71
Wobble Quad Stability 3	1	0	71
Relaxed multiloop 3	3	0	97
Five Adjacent Stem Multibranch Loop	1	1	67
SHAPE Profile - C-A Mismatch - Pilot Run	2	0	85
SHAPE Profile - A-C Mismatch - Pilot Run	1	0	46
SHAPE Profile - G-A Mismatch - Pilot Run	1	0	87
SHAPE Profile - A-G Mismatch - Pilot Run	1	0	93
Unmodified tRNA sequences	1	1	93
Chicken Leg - Reversed	1	0	94
Reversed motor - step 1	1	0	96
Reversed motor - Step 2	3	0	94
Reversed motor - Step 3	3	0	98
Reversed motor - Step 4	3	0	94
Double 1-3 Loop	1	0	94
A codon riboswitch	1	0	93
SHAPE Profile - C-C Mismatch - Pilot Run	1	0	99
Reversed G-C Multibranch Loop Closing Base Pairs 2	1	0	72
Reversed G-C Multibranch Loop Closing Base Pairs 3	3	0	74
A-U Closing Base Pairs 3	3	0	98
A-U Closing Base Pairs 4	3	1	89
SHAPE Profile - U-U Mismatch - Pilot Run 2A	1	0	89
SHAPE Profile - U-U Mismatch - Pilot Run 2B	1	0	67

SHAPE Profile - C-U Mismatch - Pilot Run 2B	1	0	75
SHAPE Profile - A-C Mismatch - Pilot Run 2A	3	0	66
SHAPE Profile - A-C Mismatch - Pilot Run 2B	1	0	87
SHAPE Profile - G-A Mismatch - Pilot Run 2A	1	0	73
SHAPE Profile - G-A Mismatch - Pilot Run 2B	3	0	82
SHAPE Profile - A-G Mismatch - Pilot Run 2A	1	0	71
SHAPE Profile - A-G Mismatch - Pilot Run 2B	1	0	68
Large GU stack	1	0	72
Tetraloop Competition Series - GAAA	1	0	70
Tetraloop Competition - UUCG	1	0	90
Tetraloop Competition Series - UACG	1	0	65
Tetraloop Competition Series - GAGA	1	0	64
Neck strength analysis 1 of 3 - Strong - alternating GCs.	3	0	72
Neck strength analysis 2 of 3 - Medium - alternating AUs.	3	0	74
Neck strength analysis 3 of 3 - Weak - AUs + GUs.	1	0	54
T.thermophilisel16S Hammerhead	3	0	95
Hexaloop Kd and SHAPE test	2	0	96
SHAPE Profile - C-C Mismatch - Pilot Run 2A	1	0	93
SHAPE Profile - C-C Mismatch - Pilot Run 2B	3	0	75
SHAPE Profile - A-A Mismatch - Pilot Run 2A	3	0	66
SHAPE Profile - A-A Mismatch - Pilot Run	1	0	87
Alien partial glasses - Mirror version	3	0	93
Single to Switch try #2 - Mirror version	3	0	78
Let's break the barcode	3	1	100
Repeatability - Melted Helix Variation 1	1	0	81
Repeatability - Melted Helix Variation 2	1	0	67
SHAPE Profile - Most Likely Base Pair C/G	1	0	85
SHAPE Profile - Most Likely Base Pair U/A - Variation 1.1	1	0	83
SHAPE Profile - Most Likely Base Pair U/A - Variation 1.3	1	0	84

SHAPE Profile - Most Likely Base Pair G/C - Variation 2	1	0	79
Don Quixote	3	0	94
Early bulge control	1	0	97
Late bulge	3	0	75
Late bulge control	3	0	94
Really big loop coil - Classic science toy	1	0	67
Intrinsically Red	3	0	65
Intrinsical - Frequency 1	1	0	43
Intrinsical - Frequency 3	3	0	11
Intrinsical - Frequency 4	3	0	14
Intrinsical - Frequency 5	1	0	89
Intrinsical - Frequency 8	1	0	12
Mummiebrain's M2	3	0	89
Impossible Folding I	1	0	79
Impossible Folding II - The Intramolecular G-quadruplex	3	0	91
Poly (A) Structure Analysis Rerun	2	0	68
New Frontier 3	1	1	71
Triloop Hairpin and Stem Loop - Helix Stability	1	0	76
Kinky Bits	1	0	90
Short Neck and Split Ends	3	0	98
Adding some sweet triloops	3	3	80
SHAPE Profile - UUCG Tetraloop/C-G	1	0	-
SHAPE Profile - UUCG Tetraloop/G-C	3	1	-
SHAPE Profile - UUCG Tetraloop/A-U	3	0	-
SHAPE Profile - GAGUA Pentaloop	1	0	-
Ribozyme 1: Hammerhead variant	3	0	54
Kissing Hairpins	1	0	-
JR's Let's Break the Barcode - Adjacent Barcode Version	1	0	93
JR's Let's Break the Barcode - 2 nt Dangling End Gap Version	3	0	100

JR's Let's Break the Barcode - 3 nt Dangling End Gap Version	3	0	98
The G Quadruplex - Round 2	1	0	86
New Frontier 4	1	0	83
Ribozyme 2: Cutters, Knots and Viruses	1	0	-
The Donkey's Tail	1	0	98
GGG/UCC Wobble Closing Base Pairs - Octaloop	1	0	-
Stability Quest 1	1	0	-
SAM II Riboswitch	1	1	88
R-U Closing Base Pairs - Round 4	1	0	97
Motif study: the S-turn	1	0	61
Improving the Energy Model: Favoring an Equivalent Structure	3	3	76
Improving the Energy Model: 5-Base Hairpin Loops	3	3	70
Mad multiloop - Frozen target	1	0	98
Coaxial stacking of the barcode - a mechanism for "barcode interference"	1	1	84
Return of the boost	1	0	97
Comparison of Terminal Mismatch Stability - Multibranch Loop Pilot	5	0	88
Ribozyme 3: The Hairpin Ribozyme	3	0	90
FMN Mimic Pilot Sequences - Chemical Mapping Profile	1	0	72
Unconventional RNA Structure and Sequence Design	4	4	78
Thermodynamic Mimics: A Method for Simulating Functional Riboswitches	2	2	66
Eterna History Tour - Introduction to Lab	12	6	88
MS2 Riboswitches On Chip	1	1	43
Thermodynamic Mimics - Round 2	1	0	96
Eterna History Tour - Introduction to Lab - The Cross lab	1	1	91
Eterna History Tour - Introduction to Lab - Bulged Cross	1	1	84
Eterna3D Tetraloop Receptor Puzzle	1	0	-

Eterna History Tour - Introduction to Lab - The Asymmetry lab	1	0	72
Thermodynamic Mimics: A Method for simulating Riboswitch systems - Round 3	1	0	79
MS2 Cooperative Binding	1	1	-
Next Generation Riboswitches On Chip	1	1	71
MS2 Cooperative Binding - Round 3	5	5	60
OpenTB - Getting started Round 2	1	1	-
OpenCRISPR - Controls	2	0	-
OpenCRISPR - Tetracycline	1	0	-
Testing Lab mgotrik	12	0	-
OpenRibosome Pilot Challenge Warm-up	1	0	-
OpenVaccine: [Lightning Round] Eterna takes on the Coronavirus	6	0	75
OpenVaccine: "Roll Your Own Structure", RNA backbone stability in aqueous solution	42	42	100
OpenVaccine: [Round 2] Design of eGFP and epitope mRNA molecules	10	0	-

TOTAL (#): The total number of design submissions made to an Eterna challenge.

TESTED: The total number of design submissions made to an Eterna challenge that were experimentally tested.

BEST (%): Player's best score (as a percentage) for experimentally tested design submissions made to an Eterna challenge

