Grant Newton Remmen — Curriculum Vitae

CONTACT INFORMATION

Kavli Institute for Theoretical Physics
University of California, Santa Barbara

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web: grantremmen.com

POSITIONS

University of California, Santa Barbara, Fundamental Physics Fellow — 2020–present
Kavli Institute for Theoretical Physics, Postdoctoral Scholar

University of California, Berkeley, Miller Research Fellow — 2017–2020

Harvard University Society of Fellows, Junior Fellow (declined) — 2017

EDUCATION

California Institute of Technology — 2012–2017
Ph.D., Physics — June 2017
M.S., Physics — June 2015
Hertz Fellow and NSF Graduate Research Fellow

University of Minnesota, College of Science & Engineering — 2008–2012
B.S., Physics, *summa cum laude*, High Distinction, 4.0 GPA — May 2012
B.S., Astrophysics, *summa cum laude*, High Distinction, 4.0 GPA — May 2012
B.S., Mathematics, *summa cum laude*, High Distinction, 4.0 GPA — May 2012

HONORS & AWARDS

Appointed as Hertz Fellowship Interviewer — 2018–present
Sakurai Dissertation Award in Theoretical Particle Physics — 2018
American Physical Society award citation: "For his contributions to understanding the structure and self-consistency of gravity and effective field theories using ideas from quantum field theory and holography."
Stemple Memorial Prize in Physics, Caltech — 2016
Delegate to the 66$^{\text{th}}$ Lindau Nobel Laureate Meeting — 2016
Hertz Fellow — 2012–2017
NSF Graduate Research Fellow, National Science Foundation — 2012–2017
Goldwater Scholar — 2010–2012
Chambliss Astronomy Achievement Student Award, American Astronomical Society — 2011
Dean's Summer International Student Scholarship, University College London — 2011
United States Presidential Scholar, White House Commission on Presidential Scholars & U.S. Dept. of Education — 2008
National Merit Scholar — 2008–2012
Byrd Honors Scholar — 2008–2011
Hagstrum Award in Physics, Univ. of MN — 2012
Outstanding Graduate in Mathematics, Univ. of MN — 2012
Franklin Scholarship in Physics, Univ. of MN — 2011–2012
Lando Scholarship in Mathematics, Univ. of MN — 2011–2012
Richards Scholarship in Mathematics, Univ. of MN — 2011–2012
Nier Scholarship in Physics, Univ. of MN — 2010–2011
Thorp Scholarship in Mathematics, Univ. of MN — 2010–2011
Undergraduate Research Scholarship, Univ. of MN — 2010
Basford Award in Physics, Univ. of MN — 2009–2010
Institute of Technology Alumni Award, Univ. of MN — 2009–2010
Institute of Technology Honors Undergraduate Research Scholarship, Univ. of MN — 2009
Maroon & Gold Leadership Award, Univ. of MN — 2008–2012
3M/Alumni Award, Univ. of MN — 2008–2012
Bentson Scholar, Univ. of MN — 2008–2012
Dean's List, Univ. of MN College of Science & Engineering/Institute of Technology — 2008–2012
McGraw Hill Student Achievement Recognition, Univ. of MN, for Meritorious Work in General Chemistry — 2008

PUBLICATIONS

51. Clifford Cheung, **Grant N. Remmen** — under review, JHEP
Veneziano Variations: How Unique are String Amplitudes? arXiv:2210.12163

50. Marat Freytsis, Soubhik Kumar, **Grant N. Remmen**, Nicholas L. Rodd — under review, JHEP
Multifield Positivity Bounds for Inflation arXiv:2210.10791

49. Juan Maldacena, **Grant N. Remmen** — JHEP **8** (2022) 152
Accumulation-Point Amplitudes in String Theory arXiv:2207.06426

48. **Grant N. Remmen**, Nicholas L. Rodd — JHEP **9** (2022) 30
Spinning Sum Rules for the Dimension-Six SMEFT arXiv:2206.13524

47. Yu-tin Huang, **Grant N. Remmen** — Phys. Rev. D **106** (2022) L021902
UV-Complete Gravity Amplitudes and the Triple Product arXiv:2203.00696

46. Achilleas P. Porfyriadis, **Grant N. Remmen** — JHEP **3** (2022) 107
Large Diffeomorphisms and Accidental Symmetry of the Extremal Horizon arXiv:2112.13853

45. **Grant N. Remmen** — Gen. Rel. Grav. **53** (2021) 101
Exploration of a Singular Fluid Spacetime arXiv:2111.08713

44. Nima Arkani-Hamed, Yu-tin Huang, Jin-Yu Liu, **Grant N. Remmen** — JHEP **3** (2022) 83
Causality, Unitarity, and the Weak Gravity Conjecture arXiv:2109.13937

43. **Grant N. Remmen** — Phys. Rev. Lett. **127** (2021) 241602, Editors' Suggestion
Amplitudes and the Riemann Zeta Function arXiv:2108.07820

42. Achilleas P. Porfyriadis, **Grant N. Remmen** — JHEP **10** (2021) 142
Horizon Acoustics of the GHS Black Hole and the Spectrum of AdS_2 arXiv:2106.10282

41. Ning Bao, Aidan Chatwin-Davies, **Grant N. Remmen** — JHEP **7** (2021) 113
Entanglement Wedge Cross Section Inequalities from Replicated Geometries arXiv:2106.02640

40. Ning Bao, Jonathan Harper, **Grant N. Remmen** — Phys. Rev. D **105** (2022) 026010
Holevo Information of Black Hole Mesostates arXiv:2103.06888

39. **Grant N. Remmen**, Nicholas L. Rodd — Phys. Rev. D **105** (2022) 036006
Signs, Spin, SMEFT: Sum Rules at Dimension Six arXiv:2010.04723

38. Rafael Aoude et al. (including **Grant N. Remmen**) — Snowmass 2021 Letter of Interest
On-Shell Methods for the SMEFT

37. Ning Bao, Aidan Chatwin-Davies, **Grant N. Remmen** — JHEP **9** (2020) 102
Warping Wormholes with Dust:
a Metric Construction of the Python's Lunch arXiv:2006.10762

36. **Grant N. Remmen**, Nicholas L. Rodd — Phys. Rev. Lett. **125** (2020) 081601
Flavor Constraints from Unitarity and Analyticity arXiv:2004.02885

35. Clifford Cheung, **Grant N. Remmen** — JHEP **5** (2020) 100
Entanglement and the Double Copy arXiv:2002.10470

34. Ning Bao, Aidan Chatwin-Davies, Jason Pollack, **Grant N. Remmen** — JHEP **8** (2020) 65
Cosmological Decoherence from Thermal Gravitons arXiv:1911.10207

33. **Grant N. Remmen**, Nicholas L. Rodd — JHEP **12** (2019) 32
Consistency of the Standard Model Effective Field Theory arXiv:1908.09845

32. Ning Bao, Aidan Chatwin-Davies, Jason Pollack, **Grant N. Remmen** — JHEP **7** (2019) 152
Towards a Bit Threads Derivation of
Holographic Entanglement of Purification arXiv:1905.04317

31. Clifford Cheung, Junyu Liu, **Grant N. Remmen** — Phys. Rev. D **100** (2019) 046003
Entropy Bounds on Effective Field Theory from
Rotating Dyonic Black Holes arXiv:1903.09156

30. Raphael Bousso, Yasunori Nomura, **Grant N. Remmen** — Phys. Rev. D **99** (2019) 046002
Outer Entropy and Quasilocal Energy arXiv:1812.06987

PUBLICATIONS, CONTINUED

29. Ning Bao, Aidan Chatwin-Davies, **Grant N. Remmen** JHEP **2** (2019) 110
Entanglement of Purification and Multiboundary Wormhole Geometries arXiv:1811.01983

28. **Grant N. Remmen** Phys. Rev. D **98** (2018) 124008
New Spacetimes for Rotating Dust in arXiv:1810.12305
$(2+1)$-Dimensional General Relativity

27. Ning Bao, Aidan Chatwin-Davies, Jason Pollack, **Grant N. Remmen** JHEP **11** (2018) 71
Traversable Wormholes as Quantum Channels: arXiv:1808.05963
Exploring CFT Entanglement Structure and Channel Capacity in Holography

26. Yasunori Nomura, **Grant N. Remmen** JHEP **8** (2018) 63
Area Law Unification and the Holographic Event Horizon arXiv:1805.09339

25. Venkatesa Chandrasekaran, **Grant N. Remmen**, JHEP **11** (2018) 15
Arvin Shahbazi-Moghaddam arXiv:1804.03153
Higher-Point Positivity

24. Clifford Cheung, Junyu Liu, **Grant N. Remmen** JHEP **10** (2018) 4
Proof of the Weak Gravity Conjecture from Black Hole Entropy arXiv:1801.08546

23. Ning Bao, Sean M. Carroll, Aidan Chatwin-Davies, Phys. Rev. D **97** (2018) 126014
Jason Pollack, **Grant N. Remmen** arXiv:1712.04955
Branches of the Black Hole Wave Function Need Not Contain Firewalls

22. Chris Akers, Raphael Bousso, Illan F. Halpern, Phys. Rev. D **97** (2018) 024018
Grant N. Remmen arXiv:1711.06689
Boundary of the Future of a Surface

21. Clifford Cheung, **Grant N. Remmen**, Chia-Hsien Shen, Congkao Wen JHEP **4** (2018) 129
Pions as Gluons in Higher Dimensions arXiv:1709.04932

20. Clifford Cheung, **Grant N. Remmen** JHEP **9** (2017) 2
Hidden Simplicity of the Gravity Action arXiv:1705.00626

19. Sean M. Carroll, **Grant N. Remmen** Phys. Rev. D **95** (2017) 123504
A Nonlocal Approach to the Cosmological Constant Problem arXiv:1703.09715

18. Ning Bao, **Grant N. Remmen** EPL **121** (2018) 60007, Editor's Choice
Bulk Connectedness and Boundary Entanglement arXiv:1703.00018

17. Clifford Cheung, **Grant N. Remmen** JHEP **1** (2017) 104
Twofold Symmetries of the Pure Gravity Action arXiv:1612.03927

16. Clifford Cheung, **Grant N. Remmen** Phys. Rev. Lett. **118** (2017) 051601
Positivity of Curvature-Squared Corrections in Gravity arXiv:1608.02942

15. **Grant N. Remmen**, Ning Bao, Jason Pollack JHEP **7** (2016) 48
Entanglement Conservation, ER = EPR, arXiv:1604.08217
and a New Classical Area Theorem for Wormholes

14. Sean M. Carroll, **Grant N. Remmen** Phys. Rev. D **93** (2016) 124052
What is the Entropy in Entropic Gravity? arXiv:1601.07558

13. Clifford Cheung, **Grant N. Remmen** JHEP **4** (2016) 2
Positive Signs in Massive Gravity arXiv:1601.04068

12. Ning Bao, Jason Pollack, **Grant N. Remmen** JHEP **11** (2015) 126
Wormhole and Entanglement (Non-)Detection arXiv:1509.05426
in the ER = EPR Correspondence

11. Brando Bellazzini, Clifford Cheung, **Grant N. Remmen** Phys. Rev. D **93** (2016) 064076
Quantum Gravity Constraints from Unitarity and Analyticity arXiv:1509.00851

PUBLICATIONS, CONTINUED

10. Ning Bao, Jason Pollack, **Grant N. Remmen** Fortschr. Phys. **63** (2015) 705
Splitting Spacetime and Cloning Qubits: arXiv:1506.08203
Linking No-Go Theorems across the ER = EPR Duality

9. Ning Bao, ChunJun Cao, Sean M. Carroll, Aidan Chatwin-Davies, Nicholas Hunter-Jones, Jason Pollack, **Grant N. Remmen** Phys. Rev. D **91** (2015) 125036 arXiv:1504.06632
Consistency Conditions for an AdS Multiscale Entanglement Renormalization Ansatz Correspondence

8. Clifford Cheung, **Grant N. Remmen** JHEP **12** (2014) 87
Infrared Consistency and the Weak Gravity Conjecture arXiv:1407.7865

7. **Grant N. Remmen**, Sean M. Carroll Phys. Rev. D **90** (2014) 063517
How Many e-Folds Should We Expect from High-Scale Inflation? arXiv:1405.5538

6. Clifford Cheung, **Grant N. Remmen** Phys. Rev. Lett. **113** (2014) 051601
Naturalness and the Weak Gravity Conjecture arXiv:1402.2287

5. **Grant N. Remmen**, Sean M. Carroll Phys. Rev. D **88** (2013) 083518
Attractor Solutions in Scalar-Field Cosmology arXiv:1309.2611

4. **Grant N. Remmen**, Kris Davidson, Andrea Mehner Astrophys. J. **773** (2013) 27
Unexpected Ionization Structure in Eta Carinae's "Weigelt Knots" arXiv:1302.2659

3. **Grant N. Remmen**, Kinwah Wu Mon. Not. R. Astron. Soc. **430** (2013) 1940
Complex Orbital Dynamics of a Double Neutron Star System arXiv:1301.2836
Revolving around a Massive Black Hole

2. **Grant Remmen**, Elwood McCreary JURP **25** (2012)
Measurement of the Speed and Energy Distribution of Cosmic Ray Muons

1. **Grant Remmen** JURP **23** (2010)
A New Assessment of Dark Matter in the Milky Way Galaxy

THESES

Ph.D., Physics | California Institute of Technology Defended May 2017
Grant Newton Remmen
Defining Gravity: Effective Field Theory, Entanglement, and Cosmology
Thesis advisors: Clifford Cheung and Sean M. Carroll, California Institute of Technology

B.S., Mathematics, *summa cum laude* | University of Minnesota Defended May 2012
Grant N. Remmen
Dynamics of a Rigid Spinning Ring in the Schwarzschild Metric:
A Solution to a Gravitational Problem in Mathematical Physics
Thesis advisor: Willard Miller, School of Mathematics, University of Minnesota
Research supervised by Kinwah Wu, Head of Theory,
Mullard Space Science Laboratory, University College London.

B.S., Astrophysics, *summa cum laude* | University of Minnesota Defended December 2011
Grant N. Remmen
Hubble Space Telescope *Subpixel Modeling of Anomalous*
High-Excitation Emission Lines in the Ejecta of Eta Carinae
Thesis advisor: Kris Davidson, MN Institute for Astrophysics, University of Minnesota

B.S., Physics, *summa cum laude* | University of Minnesota Defended April 2010
Grant Remmen
Distortion of Black Holes caused by Motion relative to the Cosmic Microwave Background
Thesis advisor: Robert Gehrz, Director, MN Institute for Astrophysics, University of Minnesota

TALKS

Number Theory and Physics Workshop | Simons Center for Geometry and Physics, Stony Brook University (virtual)	October 2022
Institute for Advanced Study | Amplitudes Group Meeting	October 2022
Simons Symposium on Amplitudes Meet Cosmology | Scotland	May 2022
UC Santa Barbara | High Energy and Gravity Seminar	May 2022
Possible and Impossible in Effective Field Theory: From the S-Matrix to the Swampland Workshop | Institute for Advanced Study	May 2022
Argonne National Laboratory | High Energy Physics Theory Seminar (virtual)	April 2022
Kavli IPMU, Univ. Tokyo | Mathematics - String Theory Seminar (virtual)	April 2022
California Amplitudes Meeting | UC Davis	March 2022
California Institute of Technology | Amplitudes Group Meeting	February 2022
UC Irvine | Particle Physics Seminar	January 2022
QCD Meets Gravity Workshop | UCLA (virtual)	December 2021
Kavli Institute for Theoretical Physics | Locals' Event	November 2021
UC Santa Barbara | High Energy and Gravity Seminar (virtual)	November 2021
International Centre for Theoretical Physics | High Energy, Cosmology, and Astroparticle Physics Seminar (virtual)	November 2021
Brandeis University | Quantum/Gravity Seminar (virtual)	November 2021
ETH Zürich | QFT, Strings and Beyond Seminar (virtual)	October 2021
Perimeter Institute | Quantum Fields and Strings Seminar (virtual)	October 2021
Hertz Foundation Innovation Hour (virtual)	June 2021
California Amplitudes Meeting | UCLA (virtual)	March 2021
New York University | Physics Department Colloquium (virtual)	March 2021
New York University | Physics Research Seminar (virtual)	February 2021
University of Florida | High Energy Physics Seminar (virtual)	January 2021
University of Chicago | Particle Theory Seminar (virtual)	January 2021
Korea Institute for Advanced Study | High Energy Physics Seminar (virtual)	December 2020
UC Santa Barbara | High Energy and Gravity Seminar (virtual)	November 2020
Yale University | Particle Theory Seminar (virtual)	October 2020
Brookhaven National Laboratory | High Energy Theory Seminar (virtual)	April 2020
Kavli IPMU, Univ. Tokyo | Astronomy-Cosmology-Particle Physics Seminar (virtual)	April 2020
UC Davis, QMAP | Fields, Strings, Gravity Seminar (virtual)	April 2020
The String Swampland and Quantum Gravity Constraints on Effective Theories Program | Kavli Institute for Theoretical Physics	March 2020
Brandeis University | High-Energy and Gravitational Theory Chalk Talk	January 2020
Brandeis University | Physics Department Colloquium	January 2020
University of Michigan, LCTP | High Energy Theory Seminar	November 2019
From Scattering to Expansion Workshop | Northwestern University	October 2019
UC Santa Barbara | Particle Physics Phenomenology Seminar	October 2019

TALKS, CONTINUED

UC Santa Barbara | High Energy and Gravity Seminar	October 2019
Navigating the Swampland Conference | Instituto de Física Teórica, UAM-CSIC, Madrid, Spain	September 2019
University of Washington | AdS/CFT Group Meeting	May 2019
University of Washington | Particle Theory Seminar	May 2019
University of Minnesota, FTPI | High Energy Theory Seminar	April 2019
Stanford University | Stanford Institute for Theoretical Physics Colloquium	April 2019
UC Berkeley | 4D Seminar	April 2019
California Institute of Technology | High Energy Theory Seminar	February 2019
UC Davis | Joint Theory Seminar	January 2019
Harvard University | Black Hole Initiative Colloquium	November 2018
Cornell University | Particle Theory Seminar	October 2018
Institute for Advanced Study | High Energy Theory Seminar	October 2018
Vistas over the Swampland Conference | Instituto de Física Teórica, UAM-CSIC, Madrid, Spain	September 2018
King's College London | Special Seminar, Theoretical Particle Physics & Cosmology	June 2018
Gravity, Cosmology & Physics Beyond the Standard Model Conference | LPNHE, UPMC, Paris, France	June 2018
Sakurai Thesis Prize Talk | American Physical Society April Meeting, Columbus, OH *Quantum Gravity Constraints for Effective Field Theories*	April 2018
University of Illinois, Urbana-Champaign | Mathematical and Theoretical Physics Seminar	April 2018
McGill University | High Energy Theory Group Seminar (virtual)	March 2018
California Institute of Technology | High Energy Theory Seminar	February 2018
California Institute of Technology | Quantum Spacetime Meeting	February 2018
UC Berkeley | String Seminar	February 2018
Stanford University | Stanford Institute for Theoretical Physics Seminar	January 2018
SLAC National Accelerator Laboratory | Elementary Particle Physics Theory Seminar	October 2017
Institute for Advanced Study | High Energy Theory Seminar	October 2017
Massachusetts Institute of Technology | String/Gravity Theory Seminar	May 2017
California Institute of Technology | Theoretical Physics Research Group Meeting	April 2017
California Institute of Technology | Theoretical Physics Journal Club	April 2017
UC Berkeley | String Seminar	February 2017
QCD Meets Gravity Workshop | UCLA	December 2016
California Institute of Technology | Theoretical Physics Research Group Meeting	November 2016
California Institute of Technology | Theoretical Physics Research Group Meeting	October 2016
Johns Hopkins University | High Energy Theory/Cosmology Seminar	October 2016
California Institute of Technology | Theoretical Physics Research Group Meeting	May 2016

Talks, continued	New York University | High Energy Seminar	April 2016
	Harvard University | Particle Theory Seminar	April 2016
	California Institute of Technology | Theoretical Physics Research Group Meeting	February 2016
	California Institute of Technology | Theoretical Physics Research Group Meeting	November 2015
	California Institute of Technology | Theoretical Physics Journal Club	October 2015
	California Institute of Technology | Theoretical Physics Research Group Meeting	April 2015
	California Institute of Technology | Theoretical Physics Research Group Meeting	February 2015
	California Institute of Technology | Theoretical Physics Research Group Meeting	October 2014
	California Institute of Technology | Theoretical Physics Journal Club two-part talk	October 2014
	20^{th} International Symposium on Particles, Strings and Cosmology (PASCOS 2014) | Warsaw, Poland	June 2014
	California Institute of Technology | Theoretical Physics Research Group Meeting	May 2014
	California Institute of Technology | Theoretical Physics Journal Club	February 2014
	California Institute of Technology | Theoretical Physics Research Group Meeting	February 2014
	California Institute of Technology | Theoretical Physics Journal Club	September 2013
	Hertz Foundation 50^{th} Anniversary Symposium | Poster Presentation	August 2013
	American Physical Society April Meeting, Denver, CO	April 2013
	Mullard Space Science Laboratory, United Kingdom | Theory Group Meeting	August 2011
	Dean's Summer International Student Day of Talks | University College London, United Kingdom	August 2011
	217^{th} Meeting of the American Astronomical Society, Seattle, WA | Poster Presentation	January 2011
Conference Organization	Conference Co-Chair | Kavli Institute for Theoretical Physics (virtual) *UV Meets the IR: Effective Field Theory Bounds from QFT to String Theory*	October 2020
Seminar Organization	Organizer | KITP Locals' Event Series	2022–2023
	Organizer | UC Santa Barbara High Energy and Gravity Seminar Series	2020–2021
	Organizer | UC Berkeley HEP-QIS Seminar Series	2018–2019
	Organizer | UC Berkeley String Seminar Series	2017–2019
Teaching Experience	**UC Santa Barbara, Department of Physics** Instructor and organizer of graduate short course *Impossible Physics: Constraining the Laws of Nature, from Scattering Amplitudes to Black Holes*	Fall 2020
	UC Berkeley, Department of Physics Guest lecturer in Prof. Petr Hořava's Quantum Field Theory course	April 2018
	University of Minnesota, Institute of Technology, Department of Astronomy Teaching assistant to Prof. Robert Gehrz, Department Chair	Fall 2009
Science Outreach	Outreach talk for KITP administrative staff	May 2021
	Guest lecturer for Caltech's *Storytelling for Scientists* course	April 2021
	Presented talks on dark matter to physics classes in rural Minnesota	2011

Press

The Current | UCSB — January 2022
Quantum Zeta Epiphany

Physics Magazine | American Physical Society — December 2021
A Physical Match for the Riemann Zeta Function

Quanta Magazine — May 2020
Black Hole Paradoxes Reveal a Fundamental Link Between Energy and Order

Scientific & Honorary Affiliations

American Physical Society
American Astronomical Society
International Society on General Relativity and Gravitation
Golden Key International Honour Society
Sigma Pi Sigma, National Physics Honor Society

Journal Referee

Physical Review Letters
Physical Review D
Journal of High Energy Physics
Nuclear Physics B
Scientific Reports - Nature
Communications in Mathematical Physics

Leadership, Service, & Cultural Activities

Co-author/-composer of a two-act musical, *From the Earth to the Moon*, based on the Verne novel

Caltech production of *From the Earth to the Moon* |
- Mainstage production, Assistant to the Director — 2022
- Public reading (virtual), Music Director — 2021

California Institute of Technology Graduate Student Council Board of Directors — 2013–2017
- Member, Academics Committee and Director at Large — 2016–2017
- Member, Academics Committee and Physics Representative — 2013–2016

California Institute of Technology Faculty Library Committee, Student Representative — 2013–2017

Co-author/-composer of a two-act musical, *Boldly Go!*, a musical parody based upon *Star Trek*

Caltech production of *Boldly Go!* |
- Mainstage production, Music Director — 2016
- Public reading, Music Director — 2015

University Study Abroad May Seminar: *Great Minds of the Renaissance*, Italy | — 2011
History of Renaissance scientists (Galileo, da Vinci, etc.) and societal context

University of Minnesota Gospel Choir — 2008–2010

Detroit Lakes Community Summer Band Program — 2008–2010

University of Minnesota Honors Student Association — 2008–2012

University of Minnesota volunteer caller for Admissions Office — 2008–2009

U.S. Department of Education volunteer | — 2008
Assembled hygiene kits for Washington, D.C. homeless

Test Scores

GRE Physics—Perfect Score: 990/990 — 2011
GRE General—Quantitative: 800/800, Verbal: 720/800, Analytical Writing: 5.5/6.0 — 2011
SAT—Perfect Score: 2400/2400 — 2008
SAT II—Perfect Scores: Math Level II 800/800 and Biology–Molecular 800/800 — 2008