Grand Challenges Initiative
Annual Report :: 2019-2020

CHAPMAN UNIVERSITY | Grand Challenges Initiative

From The Director

Since the emergence of COVID-19, I have frequently been asked whether or not we managed the transition to teaching online and how we will fare in the months to come. My answer is simple: The Grand Challenges Initiative is about solving problems. We approach the challenges we face as a program with the same tools and the same resolve that we try to provide to our students. We teach critical thinking, we teach problem solving, we teach complexity, we teach agility, and we teach fearlessness in the face of the unknown.

I can think of no program more important right now than the Grand Challenges Initiative. I accept that I may be biased in this opinion. But science, technology, engineering and mathematics provide us with powerful tools for understanding and addressing our most pressing challenges, whether it be the pandemic of COVID-19, systemic racism, or the unprecedented (un)natural disasters that are unfolding around us.

I am proud of everything that we have achieved in the last year to empower the next generation of leaders who are ready to provide us with innovative solutions. Our students showed that in spite of every obstacle put in their way, they are ready to make the world a better place. Our postdoctoral fellows showed that they will stop at nothing to make our student experience great while still producing more world-class research than they ever have before. And the community around us showed that they love what we are doing and want to be a part of it.

We're moving into this new academic year guided by our first-ever strategic plan, which is the result of the dedication, thoughtfulness, and creativity of our students, postdoctoral fellows, faculty, staff and our community partners. It sets a path forward that ensures we are a leader in innovative training that is effective for all of our students and all of our fellows. In the process of that training, it also seeks to maximize the positive impacts that we have on campus, around town, and for the world as a whole. I am excited.

Most immediately, we tore up our old fall semester syllabus. We cannot live through a grand challenge like COVID-19, which has affected every single aspect of our lives, and not devote ourselves to studying it and trying to contribute to solving it. We want our students to use science and engineering to make sense of what is going on around them. We want them to understand the challenges of vaccine development. We want them to become experts on the privacy concerns associated with using mobile apps for centralized contact tracing. We want them to know how they could use their cellphone and a few mirrors purchased online to build their own instrument to measure how well face masks block aerosols. And we want them to come up with and implement wildly creative ideas to solve all of the different problems that we are faced with right now. Of course, I will be calling on you to bring your energy and expertise to our students. And I will keep you posted on everything that they achieve.

With thanks for all that you do for our students and our fellows,

Greg Goldsmith, Ph.D.

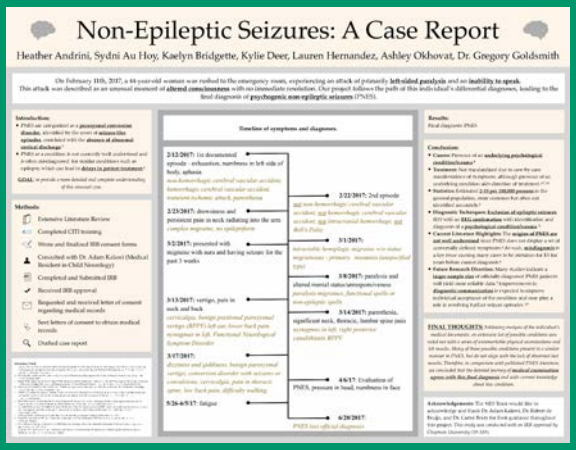
Highlights

Students

The GCI continued to grow. In fall 2019, we worked with 526 students collaborating in more than 100 teams. Student teams worked on everything from energy storage devices (flywheels) to how to grow plants on Mars. Read more at: t.ly/Vwns

Daisy Haas '21 formed a student team to study science communication and education while in the GCI. This past summer, she took her experience with her to a prestigious National Science Foundation summer undergraduate fellowship studying chemistry education with the Rochester Institute of Technology.

When COVID-19 emerged, Alex Drivas '21 took the 3D printing skills he learned in the GCI and put them to work printing PPE for frontline healthcare workers. He raised more than $3000 to buy supplies along the way. Read more at: t.ly/MLM9



This past spring, our second-year students came together for our annual project showcase. Faculty, staff, friends and family from all over the country tuned in online to check out the projects. See all of the projects at: https://blogs.chapman.edu/gci/

Highlights

Fellows + Faculty

Dr. Kelsey Gray joined the GCI on August 1st as the new assistant program director. She was most recently a Fulbright-Nehru Academic and Professional Excellence Fellow at Drepung Loseling Monastic University in South India, where she taught science to monks as part of the Emory-Tibet Science Initiative. Read more at: t.ly/InNl

Postdoctoral Fellow Dr. Zach Thammavongsy was one of only 30 early career scholars from around the world named an American Chemical Society CAS Future Fellow for his efforts to advance chemistry and chemistry education. Read more at: t.ly/Esn0

Postdoctoral Fellow Dr. Cristhiano Silva won a grant from the Foundations Questions Institute (FQX)I to study quantum physics. The GCI has now won more $300,000 in grant funding for innovative research. Read more at: t.ly/z8tf

Postdoctoral Fellow Dr. Carter Berry submitted the program's first provisional patent. His invention will allow researchers to better measure how light affect rates of plant growth. Read more at: t.ly/kRK3

Highlights

Community

MatterHackers Inc., a leading 3D-printing company based in Lake Forest, was honored this past spring by the GCI for their dedication to the program. Now, they have former Makerspace assistant Fernando Silva '19 on their staff. Read more at: t.ly/sHmp

In 2020, the GCI introduced its first community challenges, partnering student teams with organizations from the community to solve a dedicated problem. Current partners include Safe Kids Inc., which is led by Chapman alumnus Adam Coughran '04, '10. This fall, the GCI adds Earth Friendly Products as a partner. Read more at: t.ly/2Hwc

The GCI holds two annual networking events. This past fall, more than 100 students interacted with more than 30 professionals from the community to explore different career paths. To participate this upcoming semester, send an email to: grandchallenges@chapman.edu

Every semester, we engage students with world-class scientists and engineers who are solving grand challenges every day. This past fall, we invited Dr. Joshua Fisher, a climate change scientist from NASA's Jet Propulsion Laboratory. Read more at: t.ly/XI21

Our Strategic Plan

In Brief

The mission of the Grand Challenges Initiative is to develop and deliver project-based learning that immerses undergraduate students in a transformative undergraduate science and engineering education, and gives early career teacher-scholars experience and leadership opportunities in an innovative educational and research environment. Our vision is to empower the next generation of leaders to use science and engineering to solve our planet's most pressing problems. The strategic plan outlined below is intended to provide the goals and objectives that will drive our successes in the coming years, as described by our focus on students, our postdoctoral fellows, and the community around us.

Students

The Grand Challenges Initiative Prepares Students to Use STEM to Solve Problems

- Create and maintain a sense of excitement around participation in the program.
- Embrace pedagogical practices that ensure the success of all of our students.
- Add depth to the experience by providing opportunities for students to pursue their challenges over the summer and during interterm.
- Provide students with consistent expertise in both science and engineering.

Fellows

The Grand Challenges Initiative Empowers the Next Generation of Teacher-Scholars

- Provide continuing education for faculty mentoring our fellows.
- Teach postdoctoral fellows to communicate the value of their experience in the program to potential employers.
- Generate national recognition for the GCI Postdoctoral Teaching and Research Fellows Program.

Community

The Grand Challenges Initiative Makes the World Around Us a Better Place

- Build our community and our connection to the community around us through service learning activities.
- Establish a series of community challenges partnering individuals and organizations in the community with student teams.
- Communicate the value we create for the world around us to local, regional and national audiences.

Publications

Peer-Reviewed (Since 2018)

1. Åberg, J, Ranieri, N., **Duarte, C.** Chaves R. (In Press) Semidefinite tests for quantum network topologies. Phys. Rev. Letters

2. Amaral B**, Duarte C.** 2019. Characterizing and quantifying extended contextuality. Phys. Rev. A 100, 062103

3. **Berry ZC**, Emery NC, Gotsch SG, Goldsmith GR. 2018. Foliar water uptake: processes, pathways, and integration into plant water budgets. Plant, Cell & Environment 42: 410-423.

4. **Berry ZC**, Espejel X, Williams-Linera G, Asbjornsen H. 2019. Linking coordinated hydraulic traits to drought and recovery responses in a tropical montane cloud forest. Am J Bot. 106(10):1316–1326. doi:10.1002/ajb2.1356.

5. **Berry ZC**, Goldsmith GR. 2020. Diffuse light and wetting differentially affect tropical tree leaf photosynthesis. New Phytol. 225(1):143–153. doi:10.1111/nph.16121.

6. **de Bruijn R**, Wright-Lichter JX, Khoshaba E, Holloway F, Lopes PC. 2020. Baseline corticosterone is associated with parental care in virgin Japanese quail (Coturnix japonica). Hormones and Behavior. 1;124:104781.

7. de Bruyn, WJ, Clark CD, Senstad M, Toms N, and **Harrison, AW**. 2020. Biological Degradation of Ethanol in Southern California Coastal Seawater. Marine Chemistry, 103703.

8. Dietrich N, Jimenez M, **Harrison AW**, Coudret C, Olmos E. 2020. Using Pop-Culture to Engage Students in the Classroom. Journal of Chemical Education.

9. Dressel J, **Gonzãlez Alonso JR**, Waegell M, Yunger Halpern N. Strengthening weak measurements of qubit out-of-time-order correlators. Physical Review A. 2018; 98(1):012132.

10. **Duarte C**, Brito S, Amaral B, Chaves R. 2018. Concentration phenomena in the geometry of Bell correlations. Physical Review A. 98(6):062114.

11. **Duarte C.** 2020. Compatibility between agents as a tool for coarse-grained descriptions of quantum systems. Journal of Physics A: Mathematical and Theoretical.

12. **Gonzãlez Alonso JR,** Halpern NY, Dressel J. 2019. Out-of-time-ordered-correlator quasiprobabilities robustly witness scrambling. Physical Review Letters 122(4):040404.

13. Grossiord C, Christoffersen B, Alonso-Rodríguez AM, Anderson-Teixeira K, Asbjornsen H, Aparecido LMT, **Berry, ZC**, Baraloto C, Bonal D, Borrego I, et al. 2019. Precipitation mediates sap flux sensitivity to evaporative demand in the neotropics. Oecologia. 191(3):519–530. doi:10.1007/s00442-019-04513-x.

14. Halbritter AH, De Boeck HJ, Eycott AE, Reinsch S, Robinson DA, Vicca S, Berauer B, Christiansen CT, Estiarte M, Grünzweig JM, et al. including **Berry ZC**. 2020. The handbook for standardized field and laboratory measurements in terrestrial climate change experiments and observational studies (ClimEx). Freckleton R, editor. Methods Ecol Evol. 11(1):22–37. doi:10.1111/2041-210X.13331.

15. **Harrison, AW**, Waterson, AM and de Bruyn, WJ. 2020. Spectroscopic and Photochemical Properties of Secondary Brown Carbon from Aqueous Reactions of Methylglyoxal. ACS Earth and Space Chemistry. 4, 5, 762

16. Jain G, Starksen M, Singh K, Hoang C, Yancey P, **McCord C**, Fudge DS. 2019. High concentrations of trimethylamines in slime glands inhibit skein unraveling in Pacific hagfish. Journal of Experimental Biology. 222(22).

Publications

Peer-Reviewed (Since 2018)

17. Jones KW, Mayer A, Von Thaden J, **Berry ZC**, López-Ramírez S, Salcone J, Manson RH, Asbjornsen H. 2020. Measuring the net benefits of payments for hydrological services programs in Mexico. Ecological Economics. 175:106666. doi:10.1016/j.ecolecon.2020.106666.

18. Knipfer T, Reyes C, Earles JM, **Berry ZC**, Johnson DM, Brodersen CR, McElron AJ. 2019. Spatiotemporal coupling of vessel cavitation and discharge of stored xylem water in a tree sapling. Plant Physiology 179: 1658-1668.

19. Leifer MS, **Duarte C**. 2020. Noncontextuality inequalities from antidistinguishability. Phys. Rev. A 101, 062113

20. López-Ramírez SM, Sáenz L, Mayer A, Muñoz-Villers LE, Asbjornsen H, **Berry ZC**, Looker N, Manson R, Gómez-Aguilar LR. 2020. Land use change effects on catchment streamflow response in a humid tropical montane cloud forest region, central Veracruz, Mexico. Hydrological Processes. 34(16):3555–3570. doi:10.1002/hyp.13800.

21. **McCord CL**, Whiteley E, Liang J, Trejo C, Caputo R, Itehua E, Hasan H, Hernandez S, Jagnandan K, Fudge D. 2020. Concentration effects of three common fish anesthetics on Pacific hagfish (Eptatretus stoutii). Fish Physiology and Biochemistry. 18:1-3.

22. Mohseninia R, **Alonso JRG**, Dressel J. 2019. Optimizing measurement strengths for qubit quasiprobabilities behind out-of-time-ordered correlators. Physical Review A. 27;100(6):062336.

23. **Ng CA** & Micheli F. 2020. Short-term effects of hypoxia are more important than effects of ocean acidification on grazing interactions with juvenile giant kelp (Macrocystis pyrifera). Scientific Reports 10:5403.

24. **Ng CA** & Micheli F. 2020. Size-dependent vulnerability to herbivory in a coastal foundation species. Oecologia 193:199-209.

25. Pischke EC, **Berry ZC**, Kolka RK, Salcone J, Cordoba D, Shinbrot X, Lopez Ramirez SM, Jones KW, Congalton RG, Manson RH, Von Thaden Ugalde JJ, Selfa T, Avila S, Asbjornsen H. 2019. Lessons Learned About Collaborating Across Coupled Human-Natural Systems Research on Mexico's Payments for Hydrological Services Program. In Collaboration Across Boundaries for Interdisciplinary Environmental Systems Science: Experiences Around the World. Edited by Stephen Perz. Palgrave Macmillan.

26. Piper WH, Grear J, **Hoover BA**, Myers MW, & Lomery E. (In Press). Loons on the Wane: Plunging Chick and Floater Survival Cause Population Decline in a Northern Icon. Condor.

27. Rai A, **Duarte C**, Brito S, Chaves R. 2019. Geometry of the quantum set on no-signaling faces. Physical Review A. 99(3):032106.

28. Rizzuti B, Gaio L, **Duarte C**. 2020. Operational Approach to the Topological Structure of the Physical Space. Foundations of Science.

29. Solander KC, Newman BD, Carioca de Araujo A, Barnard HR, **Berry ZC**, Bonal D, Bretfeld M, Burban B, Antonio Candido L, Célleri R, et al. 2020. The pantropical response of soil moisture to El Niño. Hydrol Earth Syst Sci. 24(5):2303–2322. doi:10.5194/hess-24-2303-2020.

30. **Welles SR** and Funk JL. (In Press) Patterns of intraspecific trait variation along an aridity gradient suggest both drought escape and drought tolerance strategies in an invasive herb. Annals of Botany.

Publications

In Review and Revision

1. Cornwall ZA, **Harrison AW**, and Murray C. (Submitted) Kinetics of the Reactions of CH2OO with Acetone, α-Diketones, and β-Diketones. Physical Chemistry Chemical Physics.

2. Durant OG, Funk JL, & **Welles SR**. (In Review). Hybridization patterns in a novel contact zone of native California sunflowers: implications for restoration. Restoration Ecology.

3. **Hoover BA**, Piper WH, Banfield N, Brunk KE, Jukkala, GN, & Rypel A. (In Review). Early evidence of natal-habitat preference: juvenile loons feed on natal-like lakes after fledging. Evolution and Ecology

4. **Hoover BA**, Garcia-Rayes MA, Batten S & Sydeman WJ. (In Revision). Spatio-temporal Persistence in Mesoscale/Regional Zooplankton Communities in the Eastern North Pacific. PLOS One.

5. Heal ME, **Hoover BA** & Waggit, J. (In Revision). Using rangefinder binoculars to measure fine-scale movement of European Shag Phalacrocorax aristotelis in tidal stream environments. Bird Study/Ringing and Migration.

6. Hsu, J.L. & **G.R. Goldsmith** (In Review). Evidence-based strategies for alleviating stress and anxiety among college and university students. CBE Life Sciences Education.

7. Low NHN, **Ng CA**, Micheli F. (Conditionally Accepted). A low-cost modular control system for multi-stressor experiments. Limnology and Oceanography: Methods.

8. **Ng CA**, Micheli F. (In Review). Juvenile giant kelp survival is associated with changes in oxygen variability throughout an upwelling season. Frontiers in Marine Science.

9. **Quides KW**, Salaheldine F, Jariwala R, & Sachs JL. (In Review). Interspecific conflict over host investment into symbiotic organs. Evolution.

10. **Quides KW** & Atamian HS. (In Review). Engineering a framework for evaluating the legume microbiome. Applied and Environmental Microbiology.

11. Sin SW, **Hoover BA**, Edwards SJ, Nevitt GN, & Edwards GN. (In Review). Demographic history rather than mating system predicts signatures of inbreeding and inbreeding depression in an outbred population of seabirds. American Naturalist.

12. Vieira CH, **Duarte C**, Drumond R, Terra Cunha M. 2020. Bell Non-Locality in Many Body Quantum Systems with Exponential Decay of Correlations. arXiv preprint arXiv:2006.05537

In The News

OC Register; USA Today; Newport Beach Patch; Laguna Beach Independent; Orange County Business Journal; Orange Coast Magazine; Chemical and Engineering News; Chronicle of Higher Education; The Desert Sun; Newsweek; Smithsonian.com; CNET; Sacramento Bee and More!

#problemsolved

To find out more about how you can join us:

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grandchallenges@chapman.edu