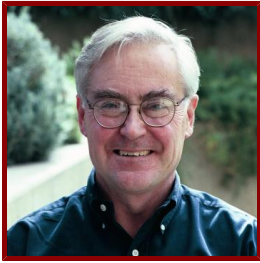


Stanford



H. Craig Heller

Lorry I. Lokey/Business Wire Professor
Biology

CONTACT INFORMATION

- **Alternate Contact**

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Bio

BIO

Dr. Heller's laboratory currently works in two rather different areas: The roles of sleep and circadian rhythms in learning and memory, and human temperature regulation. The focus in the first area of the lab's work is on the learning disability of Down syndrome. This work has resulted in identification of a class of drugs that restores the ability to learn and remember in mouse models of Down syndrome. One of these compounds has already been in phase 2 clinical studies. This work has led to the discovery of a previously unrecognized function of circadian rhythms that promotes the consolidation of memories during sleep.

The second area of the Heller lab's research is human temperature regulation. Dr. Heller has studied the brain control of body temperature in mammals for many years, much of it focused on hibernation. This work led to the development of a post-anesthesia method to rewarm patients. A resulting discovery was that the primary heat exchange body surfaces of humans are the glabrous skin of the palms, soles, and face. Subsequently the lab developed a technology to rapidly extract heat from the body through one or more of these surfaces. Using such devices, the lab discovered that the major cause of muscle fatigue and failure is rise in temperature of the muscle, and extraction of heat leads to rapid recovery and continued work capacity. Increasing work volume dramatically increases physical conditioning. A commercial version of this technology is now used in athletics. Additional applications include continuous cooling of workers in personal protection gear such as that worn by fire-fighters and hazmat workers, and any other individuals who have to work in the high heat or while being encapsulated for protection from biological or radiological hazards. Other applications include reduction of symptoms in MS patients and going back to our original work, perioperative temperature management of human and veterinary patients.

ACADEMIC APPOINTMENTS

- Professor, Biology
- Member, Bio-X
- Member, Cardiovascular Institute
- Member, Wu Tsai Human Performance Alliance
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Chair, Faculty Senate, (1983-1984)

- Director, Human Biology, (1985-1992)
- Chair, University Committee on Undergraduate Studies, (1987-1988)
- Chair, University Committee on Research, (1992-1994)
- Associate Dean, Dean of Research, (1994-1997)
- Chair, Biological Sciences, (1997-2001)
- Member and past chair, Defense Science Research Council, (2000-2015)
- Chair, Wallenberg Global Learning Network Steering Committee, (2001-2016)
- Director, BSCS, (2018-2024)
- President, Sleep Research Society, (2020-2022)

HONORS AND AWARDS

- Walter J. Gores Award for Excellence in Teaching, University (1977)
- Bing Professor of Human Biology, Human Biology (1987-1993)
- Lorry I. Lokey Business Wire Professor, Biology/Human Biology (1993-present)
- William and Lynde Steere University Fellow, University (2004-present)
- Kenneth M. Cuthertson Award for Exceptional Contributions to Stanford University, University (2010)

PROFESSIONAL EDUCATION

- PhD, Yale University , Biology (1970)

LINKS

- Website: <https://dsresearch.stanford.edu>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Neurobiology of sleep, circadian rhythms, regulation of body temperature, mammalian hibernation, and human exercise physiology. We study neural mechanisms controlling arousal states and arousal state transitions, the function of sleep, and the neural mechanisms of circadian rhythms. Research on human exercise physiology focuses on the effects of body temperature on physical conditioning and performance. The focus on Down syndrome is exploring the mechanism whereby reduction of GABA activity restores learning and memory in DS mice and also in mouse models of Alzheimer's disease.

Teaching

COURSES

2023-24

- Physiology: BIO 84 (Win)
- The Human Organism: HUMBIO 4A (Spr)
- The Neurobiology of Sleep: BIO 149, BIO 249, HUMBIO 161, PSYC 149, PSYC 261 (Win)

2022-23

- The Human Organism: HUMBIO 4A (Spr)
- The Neurobiology of Sleep: BIO 149, BIO 249, HUMBIO 161, PSYC 149, PSYC 261 (Win, Spr)

2021-22

- The Human Organism: HUMBIO 4A (Spr)

- The Neurobiology of Sleep: BIO 149, BIO 249, HUMBIO 161, PSYC 149, PSYC 261 (Win)

2020-21

- The Human Organism: HUMBIO 4A (Spr)

STANFORD ADVISEES

Undergraduate Major Advisor

Lusciana Gomez

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biology (School of Humanities and Sciences) (Phd Program)
- Neurosciences (Phd Program)

Publications

PUBLICATIONS

- **The Negative Effects of Travel on Student Athletes Through Sleep and Circadian Disruption.** *Journal of biological rhythms*
Heller, H. C., Herzog, E., Brager, A., Poe, G., Allada, R., Scheer, F., Carskadon, M., de la Iglesia, H. O., Jang, R., Montero, A., Wright, K., Mouraine, P., Walker, et al
2023: 7487304231207330
- **"Count on Sleep": an OSA awareness project update.** *Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine*
Martin, J. L., Rowley, J., Goel, N., Heller, H. C., Gurubhagavatula, I., Del Rosso, L., Rodriguez, A., Clark, M., Rice-Conboy, L.
2023
- **Beyond the Symptom: The Biology of Fatigue.** *Sleep*
Raizen, D. M., Mullington, J., Anaclet, C., Clarke, G., Critchley, H., Dantzer, R., Davis, R., Drew, K. L., Fessel, J., Fuller, P. M., Gibson, E. M., Harrington, M., Lipkin, et al
2023
- **Reversible Suppression of Fear Memory Recall by Transient Circadian Arrhythmia** *FRONTIERS IN INTEGRATIVE NEUROSCIENCE*
Steiger, A., Farfan, J., Fisher, N., Heller, H., Fernandez, F., Ruby, N. F.
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- **Inhibiting USP16 rescues stem cell aging and memory in an Alzheimer's model.** *eLife*
Reinitz, F., Chen, E. Y., Nicolis di Robilant, B., Chuluun, B., Antony, J., Jones, R. C., Gubbi, N., Lee, K., Ho, W. H., Kolluru, S. S., Qian, D., Adorno, M., Piltti, et al
2022; 11
- **"Connecting concepts helps put main ideas together": cognitive load and usability in learning biology with an AI-enriched textbook** *INTERNATIONAL JOURNAL OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION*
Koc-Januchta, M. M., Schonborn, K. J., Roehrig, C., Chaudhri, V. K., Tibell, L. E., Heller, H.
2022; 19 (1)
- **Hyper-rigid phasic organisation of hippocampal activity but normal spatial properties of CA1 place cells in the Ts65Dn mouse model of Down Syndrome.** *The Journal of neuroscience : the official journal of the Society for Neuroscience*
Munn, R. G., Freeburn, A., Finn, D. P., Heller, H. C.
1800
- **Aging disrupts circadian gene regulation and function in macrophages.** *Nature immunology*
Blacher, E., Tsai, C., Litichevskiy, L., Shipony, Z., Iweka, C. A., Schneider, K. M., Chuluun, B., Heller, H. C., Menon, V., Thaïss, C. A., Andreasson, K. I.
1800
- **Astrocytes are more dynamic players in brain functions than previously recognized.** *Sleep medicine reviews*
Heller, H. C.

2021; 59: 101520

- **Disruption of circadian timing increases synaptic inhibition and reduces cholinergic responsiveness in the dentate gyrus.** *Hippocampus*
McMartin, L., Kiraly, M., Heller, H. C., Madison, D. V., Ruby, N. F.
2021
- **Question what is "known".** *Neurobiology of sleep and circadian rhythms*
Heller, H. C.
2021; 10: 100062
- **Engaging With Biology by Asking Questions: Investigating Students' Interaction and Learning With an Artificial Intelligence-Enriched Textbook** *JOURNAL OF EDUCATIONAL COMPUTING RESEARCH*
Koc-Januchta, M. M., Schoenborn, K. J., Tibell, L. E., Chaudhri, V. K., Heller, H.
2020
- **Loss of Circadian Timing Disrupts Theta Episodes during Object Exploration.** *Clocks & sleep*
Loewke, A. C., Garrett, A. n., Steiger, A. n., Fisher, N. n., Heller, H. C., Colas, D. n., Ruby, N. F.
2020; 2 (4): 523–35
- **Suprachiasmatic lesions restore object recognition in down syndrome model mice.** *Neurobiology of sleep and circadian rhythms*
Chuluun, B. n., Pittaras, E. n., Hong, H. n., Fisher, N. n., Colas, D. n., Ruby, N. F., Heller, H. C.
2020; 8: 100049
- **The Function(s) of Sleep.** *Handbook of experimental pharmacology*
Frank, M. G., Heller, H. C.
2019
- **Functional Interactions Between Sleep and Circadian Rhythms in Learning and Learning Disabilities.** *Handbook of experimental pharmacology*
Heller, H. C., Ruby, N. F.
2018
- **A method to reduce heat strain while clad in encapsulating outerwear.** *Journal of occupational and environmental hygiene*
Grahn, D., Makam, M., Heller, H. C.
2018: 1–20
- **Scheduled feeding restores memory and modulates c-Fos expression in the suprachiasmatic nucleus and septohippocampal complex.** *Scientific reports*
Ruby, N. F., Fisher, N., Patton, D. F., Paul, M. J., Fernandez, F., Heller, H. C.
2017; 7 (1): 6755
- **A Novel Cooling Method and Comparison of Active Rewarming of Mildly Hypothermic Subjects.** *Wilderness & environmental medicine*
Christensen, M. L., Lipman, G. S., Grahn, D. A., Shea, K. M., Einhorn, J., Heller, H. C.
2017
- **Development of Circadian Sleep Regulation in the Rat: A Longitudinal Study Under Constant Conditions** *SLEEP*
Frank, M. G., Ruby, N. F., Heller, H. C., Franken, P.
2017; 40 (3)
- **Short-term treatment with flumazenil restores long-term object memory in a mouse model of Down syndrome.** *Neurobiology of learning and memory*
Colas, D., Chuluun, B., Garner, C. C., Heller, H. C.
2017; 140: 11-16
- **Cyclooxygenase inhibition targets neurons to prevent early behavioural decline in Alzheimer's disease model mice** *BRAIN*
Woodling, N. S., Colas, D., Wang, Q., Minhas, P., Panchal, M., Liang, X., Mhatre, S. D., Brown, H., Ko, N., Zagol-Ikapitte, I., Van der Hart, M., Khroyan, T. V., Chuluun, et al
2016; 139: 2063-2081
- **Reentrainment Impairs Spatial Working Memory until Both Activity Onset and Offset Reentrain.** *Journal of biological rhythms*
Ruby, N. F., Patton, D. F., Bane, S., Looi, D., Heller, H. C.
2015; 30 (5): 408-416
- **Sleep disruption impairs haematopoietic stem cell transplantation in mice** *NATURE COMMUNICATIONS*

- Rolls, A., Pang, W. W., Ibarra, I., Colas, D., Bonnavion, P., Korin, B., Heller, H. C., Weissman, I. L., de Lecea, L.
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DeClerck, M. P., Lipman, G. S., Grahn, D. A., Cao, V., Wieland, M., Troxel, T., Heller, H. C.
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 - **A Chemical Heat Pack-Based Method For Consistent Heating of Intravenous Fluids.** *Wilderness & environmental medicine*
DeClerck, M. P., Lipman, G. S., Grahn, D. A., Cao, V., Wieland, M., Troxel, T., Heller, H. C.
2015; 26 (3): 412-416
 - **Loss of Melanopsin Photoreception and Antagonism of the Histamine H3 Receptor by Ciproxifan Inhibit Light-Induced Sleep in Mice** *PLOS ONE*
Muindi, F., Colas, D., Ikeme, J., Ruby, N. F., Heller, H. C.
2015; 10 (6)
 - **Novel Application of Chemical Cold Packs for Treatment of Exercise-Induced Hyperthermia: A Randomized Controlled Trial** *WILDERNESS & ENVIRONMENTAL MEDICINE*
Lissoway, J. B., Lipman, G. S., Grahn, D. A., Cao, V. H., Shaheen, M., Phan, S., Weiss, E. A., Heller, H. C.
2015; 26 (2): 173-179
 - **Waking up to the alarm: sleep, clocks, and making memory (s)tick.** *Frontiers in systems neuroscience*
Gerstner, J. R., Aton, S. J., Heller, H. C.
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 - **Nest building is impaired in the Ts65Dn mouse model of Down syndrome and rescued by blocking 5HT2a receptors** *NEUROBIOLOGY OF LEARNING AND MEMORY*
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 - **Dysrhythmia in the suprachiasmatic nucleus inhibits memory processing** *SCIENCE*
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 - **Circadian rhythm. Dysrhythmia in the suprachiasmatic nucleus inhibits memory processing.** *Science*
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Zeitler, J. M., Fiscaro, R. A., Ruby, N. F., Heller, H. C.
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 - **Adaptive and Pathological Inhibition of Neuroplasticity Associated With Circadian Rhythms and Sleep** *BEHAVIORAL NEUROSCIENCE*
Heller, H. C., Ruby, N. F., Rolls, A., Makam, M., Colas, D.
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 - **Retino-hypothalamic regulation of light-induced murine sleep.** *Frontiers in systems neuroscience*
Muindi, F., Zeitler, J. M., Heller, H. C.
2014; 8: 135-?
 - **Sleep to forget: interference of fear memories during sleep.** *Molecular psychiatry*
Rolls, A., Makam, M., Kroeger, D., Colas, D., De Lecea, L., Heller, H. C.
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 - **Spatial Memory and Long-Term Object Recognition Are Impaired by Circadian Arrhythmia and Restored by the GABA(A)Antagonist Pentylentetrazole** *PLOS ONE*
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2013; 8 (8)

- **Short-term treatment with the GABAA receptor antagonist pentylenetetrazole produces a sustained pro-cognitive benefit in a mouse model of Down's syndrome.** *British journal of pharmacology*
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Guenther, C. J., Miyamichi, K., Yang, H. H., Heller, H. C., Luo, L.
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- **The acute effects of light on murine sleep during the dark phase: importance of melanopsin for maintenance of light-induced sleep.** *European journal of neuroscience*
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2013; 37 (11): 1727-1736
- **WORK VOLUME AND STRENGTH TRAINING RESPONSES TO RESISTIVE EXERCISE IMPROVE WITH PERIODIC HEAT EXTRACTION FROM THE PALM** *JOURNAL OF STRENGTH AND CONDITIONING RESEARCH*
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- **Optogenetic disruption of sleep continuity impairs memory consolidation** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
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2011; 108 (32): 13305-13310
- **Response of the Human Circadian System to Millisecond Flashes of Light** *PLOS ONE*
Zeitzer, J. M., Ruby, N. F., Fiscaro, R. A., Heller, H. C.
2011; 6 (7)
- **Repeatability Is Not the Same as Accuracy** *SLEEP*
Heller, H. C.
2011; 34 (7): 839-840
- **Palm cooling between sets of resistive training improves work capacity and strength training responses** *Experimental Biology Meeting 2011*
Grahn, D. A., Cao, V. H., Nguyen, C. M., Liu, M. T., Heller, H. C.
FEDERATION AMER SOC EXP BIOL.2011
- **Hibernation in Black Bears: Independence of Metabolic Suppression from Body Temperature** *SCIENCE*
Toien, O., Blake, J., Edgar, D. M., Grahn, D. A., Heller, H. C., Barnes, B. M.
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- **Acute Light Exposure Suppresses Circadian Rhythms in Clock Gene Expression** *JOURNAL OF BIOLOGICAL RHYTHMS*
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- **Separating the Contribution of Glucocorticoids and Wakefulness to the Molecular and Electrophysiological Correlates of Sleep Homeostasis** *SLEEP*
Mongrain, V., Hernandez, S. A., Pradervand, S., Dorsaz, S., Curie, T., Hagiwara, G., Gip, P., Heller, H. C., Franken, P.
2010; 33 (9): 1147-1157
- **Circadian Locomotor Rhythms Are Normal in Ts65Dn "Down Syndrome" Mice and Unaffected by Pentylenetetrazole** *JOURNAL OF BIOLOGICAL RHYTHMS*
Ruby, N. F., Fernandez, F., Zhang, P., Klima, J., Heller, H. C., Garner, C. C.
2010; 25 (1): 63-66

- **Heat Loss Through the Glabrous Skin Surfaces of Heavily Insulated, Heat-Stressed Individuals** *ASME Summer Bioengineering Conference*
Grahn, D. A., Dillon, J. L., Heller, H. C.
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- **New neurons in the adult brain: The role of sleep and consequences of sleep loss** *SLEEP MEDICINE REVIEWS*
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2009; 13 (3): 187-194
- **Melanopsin as a Sleep Modulator: Circadian Gating of the Direct Effects of Light on Sleep and Altered Sleep Homeostasis in Opn4(-/-) Mice** *PLOS BIOLOGY*
Tsai, J. W., Hannibal, J., Hagiwara, G., Colas, D., Ruppert, E., Ruby, N. F., Heller, H. C., Franken, P., Bourgin, P.
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- **Long term repair of learning disability through short-term reduction of CNS inhibition.** *Augmented Cognition, HCII 2009. D.D. Schmorow et al. (Eds.)*
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- **No Rescue of the Impaired Homeostatic Sleep Rebound in DBA/2J Mice with Attenuation of the Stress Response**
Mongrain, V., Curie, T., Gip, P., Heller, H. C., Franken, P.
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- **Long Term Repair of Learning Disability through Short-Term Reduction of CNS Inhibition** *5th International Conference on Foundation of Augmented Cognition*
Heller, H. C., Colas, D., Ruby, N. F., Fernandez, F., Chuluun, B., Blank, M., Garner, C. C.
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- **VACUUM ENHANCED HEAT TRANSFER THROUGH MAMMALIAN RADIATOR STRUCTURES** *ASME Summer Bioengineering Conference*
Grahn, D. A., Hall, C. L., Heller, H. C.
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- **Hippocampal-dependent learning requires a functional circadian system** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
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- **Cooling via one hand improves physical performance in heat-sensitive individuals with Multiple Sclerosis: A preliminary study** *BMC NEUROLOGY*
Grahn, D. A., Murray, J. v., Heller, H. C.
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- **A non-circadian role for clock-genes in sleep homeostasis: a strain comparison** *BMC NEUROSCIENCE*
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Heller, H. C.
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Heller, H. C.
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- **Sleep restriction suppresses neurogenesis induced by hippocampus-dependent learning** *JOURNAL OF NEUROPHYSIOLOGY*
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Von Der Ohe, C. G., Darian-Smith, C., Heller, H. C.
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- **Heat extraction through the palm of one hand improves aerobic exercise endurance in a hot environment** *JOURNAL OF APPLIED PHYSIOLOGY*
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Franken, P., Gip, P., Hagiwara, G., Ruby, N. F., Heller, H. C.
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- **Glucocorticoids mediate the effects of sleep deprivation on brain glycogen and glucose levels** *17th Annual Meeting of the Associated-Professional-Sleep-Societies*
Ruby, N. F., Gip, P., Hagiwara, G., Sapolsky, R., Cao, V., Franken, P., Heller, H. C.
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