

## Peer-Assisted Team Research (PATR)

PATR provides undergraduate students the opportunity to participate in a rotation of 8 interdisciplinary research modules during their first two years at Brooklyn College. Students gain experience in designing and carrying out research plans, analyzing data and drawing conclusions, while exposing themselves to new fields of science. The seminars are often led by junior and senior peers, and offer students wider parameters and more freedom in experiment design as they gain experience from the first year to the second.

### An Undergraduate Research Seminar (URS) consists of:

- A real-world, cutting-edge and socially-relevant issue or topic described in an accessible article in the popular media (*Scientific American*, *Discovery*, TED talk, *APA Monitor*, etc).
- A follow-up carefully-chosen professional article on the same topic that students will learn to read by means of the C.R.E.A.T.E. method (*consider, read, elucidate hypothesis, analyze data and think of the next experiment*), a method that helps make literature more approachable.
- A relatively-open ended set of experiments, with clearly-defined relevant research skills.
- A discussion component based on “3 steps forward”, encouraging students to think about broader applications or implications, with ethics, feasibility, applicability and policy issues to contextualize the research in the real world.

### Year 1 URS Series:

- **Endocrine Disruption** – Students study the effects of endocrine disruptors on *p. reticulata* by designing a dosing schedule, maintaining control levels, dissecting the guppies and comparing the experimental and control gonadosomatic index for matched controls.
- **Science of Junk Food** – Nutritional labels can legally contain up to 20% error in reporting. Students use lab techniques to quantify lipid, carbohydrate and salt contents of processed foods to determine the actual error of reporting. Students also design taste preference studies to make correlations on processed foods preferred based on sugar level preference in drinks.
- **Blue Light & Sleep Patterns** – Using iPads, students design an experiment to investigate how increases in blue and white light, particularly the spectra that make smart phones and tablets bright and crisp, affect circadian rhythms, sleep patterns and the ability to focus on a task.
- **Investigating Action Potentials** – Designing their individual experiments, students will investigate the effects of stimuli on the neurons of discoïd cockroaches. Stimuli could range from sound (wavelength and/or amplitude) to oxygen deprivation to glutamate (a neurotransmitter).

### Year 2 URS Series:

- **Caffeine and Energy Drinks** – Students design their own experiment to quantify the caffeine in a sample of their choosing, compare the level to the manufacturer’s label claims and present their results. Students also design a questionnaire to gather information on how college students ingest caffeine and at what levels.
- **Experimental Evolution of Multicellularity** – Evolving from unicellular to multicellular was one of the most significant innovations in the history of life, but that transition remains poorly understood. Students will design a study to encourage unicellular yeast (*s. cerevisiae*, aka brewer’s yeast) to evolve into multicellular snowflake yeast based on settling speed.
- **Power of Walking Behavior** – Students design psychometric studies to investigate how various walking styles affect cortisol and testosterone levels.
- **Cortisol/Stress** – Investigating the effects of stress on salivary cortisol levels; students design a Trier Social Stress Test, administer it to a population, quantify the cortisol levels using ELISA and analyze the results.

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Year 1 PATR Topics	Real-World Article	CREATE Academic Article	Experiment(s)	3 Steps Forward
<b>Endocrine Disruption</b>	“Human drugs make fish flounder”, Richard A. Lovett, <i>Nature News</i> , 11/16/12, doi:10.1038/nature.2012.11843	L. Nielsen, E. Baatrup Quantitative studies on the effects of environmental estrogens on the testis of the guppy, <i>Poecilia reticulata</i> <i>Aquat. Toxicol.</i> , 80 (2) (2006), pp. 140–148, 10.1016/j.aquatox.2006.08.004	Students investigate the effects of xenoestrogens on the reproductive organs of <i>P. reticulata</i> (feeder guppy).	Questions regarding how “treated” waste water needs to be before it is dumped back into the environment work well here, as do questions extrapolating into effects humans face with artificial hormones.
<b>Science of Junk Food</b>	“(Salt + Fat 2 / Satisfying Crunch) x Pleasing Mouth Feel”, Michael Moss, <i>New York Times</i> , 2/24/13. “You are what you grow”, Michael Pollan, <i>New York Times</i> , 4/22/07.	The Chemical Interactions Underlying Tomato Flavor Preferences ( <i>Current Biology</i> 22, 1035-1039, June 5, 2012)	Fat: Solvent extraction Salt: Titration Sugar (Carbohydrates): glucose and fructose ELISA or energy measurement – ELISA is more accurate;	Public health questions based on the calories per dollar mentioned in Pollan’s article. Questions about NYC’s sugar taxes and sugared beverage bans. Ethical questions on using science to alter sodium chloride to make it taste saltier, etc.
<b>Blue Light &amp; Sleep Patterns*</b>	“Bright Screens Could Delay Bedtime”, Stephani Sutherland, <i>Scientific American</i> , 2/1/13; Ted Talk, Russell Foster, Why do we sleep?	Nocturnal Light Exposure Impairs Affective Responses in a Wavelength-Dependent Manner, <i>The Journal of Neuroscience</i> , 7 August 2013, 33(32):13081-13087;	Students design a psychometric study to investigate how blue light affects sleeping pattern using iPads and lenses to filter out blue light.	Youths under the age of 20, and especially very young children, are more susceptible to eye damage from blue light. Should the time kids spend on blue light-devices (smart phones, iPads, etc.) be regulated?
<b>Investigating Action Potentials</b>	“Neuroscience Gets Radical: How to Study Surfers’ Brain Waves”, Eliza Strickland, <i>IEEE Spectrum</i> , 10/28/14	The effect of insecticides on the action potentials of insect nerves, D. I. V. Lalonde, A. W. A. Brown, <i>Canadian Journal of Zoology</i> , (doi: 10.1139/z54-009)	Using Backyard Brains’ Spikerbox, a bioamplifier that measures action potentials, students design their own experiments to measure the effects of various stimuli on action potentials of discoid cockroaches.	Do you think repetitive environmental stimuli can permanently change action potential strength or speed? Some chemical weapons that exist today are neurotoxins that block action potentials. What should be the future of this neuroscience research?

Year 2 PATR Topics	Real-World Article	CREATE Academic Article	Experiment(s)	3 Steps Forward
<b>Caffeine &amp; Energy Drinks*</b>	“A legal performance-enhancing drink”, Tom Farrey, ESPN Go, 10/27/10 “Energy Drinks Can Take Teeth On An Irreversible Acid Trip”, Eliza Barclay, NPR Health News, 5/3/12.	A methodology for testing the erosive potential of sports drinks, S.M. Hooper et al, Journal of Dentistry (2005) 33, 343–348.	If wisdom teeth are available, a study will be designed to compare various drinks on tooth enamel. If teeth are not available, students will research other options.	Should energy drink companies be more responsible with drink contents? Should product labeling change? Does the government have any responsibility to protect and/or inform citizens of drink-induced tooth decay?
<b>Multicellularity Evolution</b>	“Yeast Experiment Hints at a Faster Evolution From Single Cells”, Carl Zimmer, <i>New York Times</i> , 1/16/12	Ratcliff, W. C., Pentz, J. T. and Travisano, M. (2013), Tempo and mode of multicellular adaptation in experimentally evolved <i>Saccharomyces Cerevisiae</i> . <i>Evolution</i> , 67: 1573–1581. doi: 10.1111/evo.12101	Evolve yeast from unicellular rod-shaped to multicellular snowflake-shaped. Each small group will decide on selection regime(s). Groups will calculate average cell number/cluster after 7, 14, 21 and 28 days.	Does yeast evolution give hints about evolution lineages in plants and/or animals? Did natural conditions favor clusters of cells? How? How does this kind of evolution relate to the evolution of human cells to cooperate with almost total precision?
<b>Power of Walking Behavior*</b>	Ted Talk, Amy Cuddy, Your Body Language Shapes Who You Are.	The Effects of Walking Behavior on Mood. Sara Snodgrass, paper presented at the APA Conference in 1986.	Students design a method to investigate how various walking styles increase feeling of power (increased testosterone and decreased cortisol, quantified by ELISA)	Is doing well in courses enough to be successful? Is it important to think about how one presents him or herself? Do parents who exhibit “power” and are successful teach those traits to their children? Does this perpetuate the same group of people in the top 1%?
<b>Cortisol &amp; Stress</b>	“Girls under stress age more rapidly, new Stanford study reveals”, Rex Sanders, <i>Stanford Daily News</i> , 10/28/20174	Kirschbaum, C., Pirke, K. M., Hellhammer, D. H. (1993). The 'Trier Social Stress Test' - A tool for investigating psychobiological stress responses in a laboratory setting. <i>Neuropsychobiology</i> , 28(1-2), 76-81.	Students study psychological experiment design, design a Trier Social Stress Test (TSST), administer it to a population, collect saliva samples and quantify cortisol levels using an enzyme-linked immunosorbent assay (ELISA), and analyze the results.	Social: Can you think of practices in other societies/cultures that you know off that helps to decrease stress? Political: Are there actions that can be implemented policy-wise to help bring down the level of stress in our society? Health: Are there actions that can be implementing health-wise to help bring down stress? Economic: Are there economic policies that can help bring down stress?

\*In development and has not been tested with students.

# Undergraduate Research Seminar - Peer Lab Instructor Manual

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*“Students will always learn best that which they have figured out for themselves, but they will learn nothing if they never get it at all. We do the students a disservice either by furnishing too much information or by not providing enough help. Our goal, then, must be to give them guidance while encouraging their development into independent workers who can think on their own”.*

-Anonymous TA philosopher

**CREATE annotated bibliography;**  
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*The C.R.E.A.T.E. (Consider, Read, Elucidate hypotheses, Analyze and interpret data, and Think of the next Experiment) teaching/learning strategy uses intensive analysis of scientific papers as the basis for deep understanding of science process, data evaluation, and the motivations/personalities of scientists themselves. The approach was developed and piloted at the City College of the City University of New York, arguably the most diverse college in the US. CREATE has subsequently been tested and demonstrated effective at promoting cognitive (critical thinking, experimental design) and affective (student self-rated attitudes, epistemological beliefs; student self-rated learning) gains in a wide variety of students from R1 universities to (in progress), community colleges. This project has been NSF-supported since 2004.*

The papers below include studies of the effectiveness of CREATE courses in various populations of students, as well as papers outlining adaptations of the full-semester original CREATE method for shorter-term implementation within otherwise traditionally-taught courses.

Visit the website [www.teachCREATE.org](http://www.teachCREATE.org) for numerous CREATE “modules” outlining sets of papers that can be taught effectively at the community or four-year college/university level using CREATE, and guides for their use.

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Hoskins, S., et al., (2007) Selective Use of Primary Literature Transforms the Classroom into a Virtual Laboratory. *Genetics*, 176 1381-1389.

*The paper outlines the development of the approach and cognitive/affective gains made in CREATE courses at a MSI*

Hoskins, S., (2008) Using a Paradigm Shift to Teach Neurobiology and the Nature of Science—a C.R.E.A.T.E.-based Approach. *Journal of Undergraduate Neuroscience Education* 6(2):A40-A52.

*A “how to use CREATE in class” paper focused on developmental neurobiology*

Hoskins, S. G., Stevens, L. M. (2009) Learning our L.I.M.I.T.S. Less is more in teaching science. *Advan. Physiol. Edu.* 33: 17-20.

*An opinion piece arguing that faculty already possess the skills they need to teach CREATE effectively; but rarely bring these skills to class.*

Hoskins, S., (2010) Developing critical reading and analysis skills by analyzing newspaper science using C.R.E.A.T.E. *The American Biology Teacher*, 72(7), 415-420.

*A paper describing an adaptation of CREATE for single 'standalone' classes or sets of classes.*

Hoskins, S.G. (2011) Teaching Science for Understanding. Chapter 8 in *Science and the Educated American*, ed. J.G. Hildebrand, J. Meinwald. American Academy for Arts and Sciences, Cambridge MA.

*An overview of CREATE and its adaptation for non-majors Biology courses.*

Duncan, D., Lubman, A., and Hoskins, S.G. (2011) Introductory Biology Textbooks Under-Represent Scientific Process. *Journal of Microbiology & Biology Education*, North America. Available at: <<http://jmbe.asm.org/index.php/jmbe/article/view/307>>.

*An examination of Introductory Biology textbooks to see whether experimental design was represented significantly.*

Hoskins, S.G., Lopatto, D., and Stevens, L.M. (2011) The C.R.E.A.T.E. Approach to Primary Literature Shifts Undergraduates' Self-Assessed Ability to Read and Analyze Journal Articles, Attitudes about Science, and Epistemological Beliefs *CBE Life Sci Educ* 10:368-378.

*Paper describes testing of a new survey instrument for examining students' attitudes, self-rated abilities and epistemological beliefs, at a MSI.*

Gottesman, Alan J. and Hoskins, Sally G. (2013) CREATE Cornerstone: Introduction to Scientific Thinking, a New Course for STEM-Interested Freshmen, Demystifies Scientific Thinking through Analysis of Scientific Literature *CBE Life Sci Educ* 12:59-72

*Paper describes development of a full-semester CREATE course for first-year STEM-interested students; testing at a MSI.*

Stevens, Leslie M. and Hoskins, Sally G., (2014) The C.R.E.A.T.E. strategy for intensive analysis of primary literature can be used effectively by newly trained faculty to produce multiple gains in diverse students. *CBE Life Sci Educ* 13:224-242.

*The paper describes CREATE workshops for faculty in the NY/NJ/PA area, and the successful testing of CREATE on five local campuses, including an R1 university, private liberal arts colleges, and large public universities, by workshop-trained faculty.*

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