RIT

2019 PROVOST'S LEARNING INNOVATIONS GRANTS
CALL FOR PROPOSALS

The **Provost's Learning Innovations Grants** (PLIG) program was developed to broaden and enrich the learning experience of RIT students by funding faculty-initiated projects that enhance student learning. Managed by the Innovative Learning Institute (ILI), this program has been designed to:

- Better support dissemination of individual faculty learning to the wider faculty population
- Integrate funding with Institute priorities
- Support the scholarship of teaching and learning

I. ELIGIBILITY

All full-time RIT faculty (tenured, tenure-track, visiting, lecturers, etc.) are eligible to apply.

II. GRANT TYPES

There are two types of grants—Exploration and Focus—for PLIG 2019. Full details are available on the Grants Types page of the PLIG website (www.rit.edu/plig).

III. USE OF GRANT FUNDS

Provost's Learning Innovations Grants for 2019 may range from $1,000-$5,000.

Examples of the use of PLIG funds include:

- Course release (reasonable, actual replacement costs for faculty members removed from teaching)
- Development of new technology-based learning tools and/or environments
- Technologies or equipment required that are not normally provided by the department/college
- Resources for research design and consultation, data collection and aggregation, instrument development and/or purchase, secure data storage, data analysis, and report generation
- Travel to support research activity and/or meet with potential funding sources

IV. PLIG TIMELINE AND TASKS

The grant timeline assumes that most recipients will use the Spring 2019 and/or Summer 2019 term(s) to plan and develop their PLIG-funded project for delivery or implementation during the Fall 2019, Spring 2020, and/or Summer 2020 term(s). The full timeline, including grantee tasks, is available on the PLIG website.

V. SELECTION COMMITTEE AND EVALUTION CRITERIA

Applications for PLIG funds are evaluated by the PLIG selection committee according to the following criteria:

- *Utility* (solves a defined problem; has potential to benefit many courses/faculty)
- *Creativity* (is a novel approach or application; represents a new paradigm)
- *Efficacy* (uses an evidence-based approach; impact to student learning and/or the student experience can be demonstrated)

The criteria are further defined, illustrated, and explained in the Proposal Evaluation section of the PLIG website.

VI. QUESTIONS

Please email plig@rit.edu with any questions about the PLIG process.

(*Examples of previously funded projects are available in the Previous Awards section of the PLIG website).*

RIT

2019 PROVOST'S LEARNING INNOVATIONS GRANTS

APPLICATION

INSTRUCTIONS

1. Complete this Application Form and save as "Lastname_Firstname_APP" (*using your name*).
2. Ask your Department Head to complete the Department Head Certification, scan and save as, "Lastname_Firstname_SIG" (*using your name*).
3. Email all documents to plig@rit.edu, ***no later than 11:59pm ET, January 21, 2019.***

If you have any questions about completing this application, please contact Michael Starenko at 585-475-5035 or mssetc@rit.edu.

APPLICANT INFORMATION

This application is for a (please select *one* type of grant):

☒ **Exploration Grant**

☐ **Focus Grant – Active Learning Across All Course Modes**

Principal Applicant Name: Christina Goudreau

Faculty Title: Professor **Email**: cgsch@rit.edu **Phone:** 475-2634
(Full-time only)

College: COS **Department:** SCMS

Department Head Name: Paul Craig **Email**: pacsch@rit.edu

Others involved in the project (if any): Jeremy Cody. Michael Coleman, Douglas Tusch, and Lea Michel

Project Name: Development and Implementation of Retrieval Cues in Organic Chemistry, and Evaluation of their Effects on Knowledge Transfer.

Total Funds Requested (*as calculated on the budget worksheet on the next page*): $5,000.00
(requests of $1,000 to $5,000 will be considered)

BUDGET

Complete the table below to calculate your budget

- The total shown on this worksheet must match the "Total funds requested" in the Applicant Information section on page 1 of this application form.
- If awarded, additional funds will be provided to cover any benefits and ITS expenses associated with the salary budget requested.
- Note that any equipment or other materials purchased with grant funds are the property of your department and revert to the department after your project is completed

Personnel	Purpose/Justification	Amount
Full-time Faculty/Staff		
Christina Goudreau	Development/Implementation/Assessment	800.00
Jeremy Cody	Development/Implementation team	800.00
Michael Coleman	Development/Implementation team	800.00
Douglas Tusch	Development/Implementation team	800.00
Lea Michel	Biochemistry consultation/Implementation	500.00
	Personnel Total	**$ 3700.00**
Travel	**Purpose/Justification**	**Amount**
Northeast Regional Meeting (NERM 2020)	Registration for Team to attend Rochester, NY NERM meeting ($250 per person x 4 organic instructors)	1000.00
	Travel Total	**$ 1000.00**
Other (*Specify*)	**Purpose/Justification**	**Amount**
HUB Printing	10 desk copies in color	300.00
	Other Total	**$ 0.00**
	Total Award Requested	**5000.00**

STATEMENT OF UTILITY (two pages maximum)

Using the evaluation criteria outlined in the Proposal Evaluation section of the PLIG website, please provide an overview of the project you are proposing, including:

- Project objectives (Impact and Scale)
- An explanation of the teaching/learning problem(s) it is designed to address
- An explanation of the significance of the project to student outcomes and/or the student experience.
- A brief description of how the project integrates with activity already underway at RIT in a priority area and/or how this approach has been successfully used at RIT already.

Chemistry students often view the organic chemistry sequence as an isolated and ineffective use of their learning time and fail to see how the material is relevant to their parallel or subsequent coursework. In contrast, the term meaningful learning has been defined as "*when a person consciously and explicitly ties new knowledge to relevant concepts or propositions they already possess."*[1] In addition to chemistry and biochemistry majors, students in the following RIT programs are also required to enroll in organic chemistry: Bioinformatics, Biology, Biomedical Science, Biotechnology, Chemical Engineering, Nutritional Sciences, Dietetics and Nutrition.

Our team has subscribed to the notion that,

"[A] successful general education program relies on the assumption that learning is transferred from one context to another to create a broad, integrated educational experience. For such a general education to be successful, faculty must see their individual courses as elements of this larger experience"[2]

Reinventing the organic chemistry sequence with the larger student experience in mind is a vast undertaking few institutions have the time and energy to pursue. It requires more than simply changing a lecture here and there. As such, we endeavor to address the challenges faced by traditional organic chemistry delivery as it relates to knowledge transfer and in doing so address other limitations to the current delivery of our course sequence.

The undergraduate student culture around organic chemistry at RIT is actually positive despite organic chemistry's bad reputation nationally as a weed-out course for pre-meds. Qualitatively, our efforts to address transfer are bolstered by the number of non-chemistry majors registering for our advanced organic chemistry course electives, the growing number of students minoring in chemistry, and the popularity of registering to be a workshop leader in organic chemistry (approx. 30+ per semester). Especially noteworthy is the increasing number of interactions our faculty have with students who approach us about topics they are covering in their other courses and asking us to help them relate the material to organic. As such, our organic team needed to understand how knowledge transfer between classes could be facilitated methodically.

Challenge 1: Development of Retrieval Cues

The organic team teaches organic chemistry using a mechanistic approach. Teaching students to draw mechanisms is widely incorporated nationally and is supported by most traditional organic textbooks. However, what makes what we do novel is the simplification and classification method we have invented over the last few years. Each organic faculty member describes each organic reaction as falling under one or a combination of **twelve distinctive mechanistic pathways**. Each of the twelve mechanisms has a name, and each mechanism has a movement that we can model using our hands (embodied cognition)[3]. Let's refer to our mechanistic classification system as retrieval cues. These retrieval cues are used exhaustively throughout the organic sequence but not in the same way among faculty. This PLIG would allow for the organic team to streamline the adoption and integration of the mechanistic retrieval cues both internal to organic chemistry and external to our courses.

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Challenge 2: Normalization of Retrieval Cues
Each member of the organic team must fully utilize the mechanistic retrieval cues both in text and in hand movement. Additionally, each mechanistic retrieval cue will have a dedicated ASL sign and ASL expansion. The ASL expansion and retrieval cue movement will be one and the same. These ASL signs and expansions will be included in ASLcore (https://aslcore.org/) once approved by the ASLcore team already assigned to organic chemistry. The twelve ASL expansions will be delivered not only to deaf and hard of hearing students (D/HH) in the courses but to hearing students as well since preliminary data shows increased cognitive gains for ASL students using the expansions. As such, the organic team's commitment to a set of retrieval cues delivered uniformly across the organic chemistry curriculum and utilized in graded items can only be ensured through the adoption of a universal set of notes.

Challenge 3: Dissemination of Retrieval Cues
Once the retrieval cues have been incorporated into the organic chemistry curriculum, it is important that they are seen and used outside of organic chemistry lecture in both parallel and subsequent courses. At this point, the challenge is to disseminate our retrieval cues to instructors teaching the organic labs (co-requisites) and faculty in courses where organic chemistry is a pre-requisite so as to promote the use of our cues into their coursework and thus facilitating knowledge transfer.

"In a survey about transfer expectations, both for sequential courses within a discipline and for courses in different disciplines, faculty said that the material was more overlapping and that they expect transfer more than students realized. Although it would be nice if students automatically recognized that the material from previous courses can go along with current content, without prompts and direction, they do not seem to assume it is possible. Reminding them that transfer is expected can go a long way to promoting transfer.[2]"

Challenge 4: Transparency to Students
It is very important that the design of retrieval cues and how they will connect to other coursework is shared openly with students in the course. Concept mapping exercises and open materials via Mycourses are all possible avenues to laying bear the intent for our methodical mechanistic pathway classification system. Asking students about what concepts we expect them to bring INTO organic chemistry from General Chemistry is one way to start the conversation regarding retrieval cues. This can thus naturally lead throughout our organic course to the new cues they are building and thus can more fully embrace the plan as a whole.

"Explicitly talking about these expectations in class, especially for first-year students, can help students know that they need to think more broadly and use retrieval cues for similar information that they have encountered elsewhere. These explicit references to transfer also communicate that students are expected to use previous knowledge, integrate what they know, and get beyond the mode of memorizing and reciting the facts from lecture.[2]"

Citations:
[1] Joseph D. Novak, D. Bob Gowin, and Gerard T. Johansen, *Science Education*, **1983**, 67 (5), 625-645.

[2] Ruth Benander and Robin Lightner, *The Journal of General Education*, **2005,** 54 (3), 199-208.

[3.] (a) Steven M. Weisberg, and Nora S. Newcombe, *Cognitive Research: Principles and Implications*, **2017** 2(38), DOI 10.1186/s41235-017-0071-6. (b) Wim T.J.L. Pouw, Tamara van Gog, and Fred Paas, *educ Psychol Rev*, **2014**, 26, 51-72.

STATEMENT OF CREATIVITY (three paragraphs maximum)

Provide a brief description of how this is a novel approach, or a new application of an existing mode or model of teaching and learning, and/or research about how teaching and learning represents a new paradigm.

The **goals of this project** are as follows:

- Enhance organic chemistry knowledge transfer for students in parallel and subsequent coursework
- Increase reported student affective gains
- Increase reported student cognitive gains

In order to achieve these goals, the key is to adopt a singular set of lecture notes that incorporate the agreed upon retrieval cues as key concepts to the material. Table 1 maps how and when each challenge will be addressed through explicit action items. In addition to these action items, each member of this grant has committed to taking ASL I and II. Four of the five members of our team are registered to begin ASL through RIT this spring as a means to better understand and participate in the ASLcore discussions and the parallel development of ASL terminology for organic chemistry.

Table 1. Timeline of activities for development, implementation, and dissemination of retrieval cues into the organic chemistry curriculum.

	Summer 2019	Fall 2019	Spring 2020	Summer 2020
1. Development of Retrieval Cues	-Meetings to develop retrieval cues and notes (Orgo I)*	-Meetings to develop retrieval cues and notes (Orgo II)*		-Meeting to reflect on adoption and edit*
2. Normalization of Retrieval Cues		-Implementation of universal notes (Orgo I)	-Implementation of universal notes (Orgo I and II)	
3. Dissemination of Retrieval Cues			-Hold workshop for faculty who teach courses supported by organic chemistry -Register to present findings at the Northeast Regional Meeting (ACS) 2020 Rochester, NY	-Hold workshop for faculty who teach courses supported by organic chemistry
4. Transparency to Students	Develop concept maps for: -The general chemistry knowledge expected students bring INTO organic - The organic knowledge expected to carry OUT to other courses	-Integrate concepts into peer-led workshops -Administer concept map exercises pre- and post- organic chemistry	-Integrate concepts into peer-led workshops -Administer concept map exercises pre- and post-organic chemistry	

*indicates the most time consuming portion of the work

STATEMENT OF EFFICACY (two pages maximum)

Provide a brief description of the experiment/research design, methodology, and methods of data collection and analysis you will use to gauge efficacy.

Our assessment and evaluation plan will provide formative feedback to guide the development of the knowledge transfer project and summative assessment of the effectiveness of the project in achieving its goals as well as expected and unexpected outcomes. The efficacy of implementing retrieval cues across a broad curriculum will be assessed using the following methods:

- Meaningful Learning in the Laboratory Instrument (MLLI)[4]
- Summative Grade Comparisons
- Instructor feedback (both formal and informal)

Table 2. A relationship map linking the assessment instruments used for each proposed project goal.

	Assessment		
Project Goal	***MLLI***	***Summative Grades***	***Instructor Feedback***
Transfer of knowledge	✓	✓	✓
Reported Student affective gains	✓		✓
Reported Student cognitive gains	✓	✓	

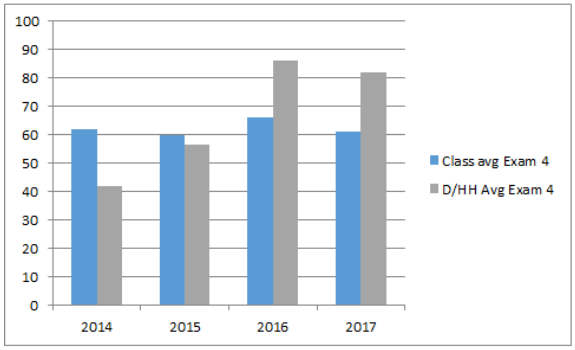
Co-requisite labs to the course already suffer from gaps in knowledge transfer simply because the lab course is a separate registration and is graded independently from the lecture course. As such, measuring the degree of knowledge transfer from the lecture to the lab course is an ideal starting point for our assessment instruments. Table 2 describes how each of our project goals is mapped to an assessment method.

The main assessment method employed will be the Meaningful Learning in the Lab Instrument (MLLI)[4] This vetted survey is designed to measure students' expectations before and after laboratory courses, in both the cognitive and affective domains. It is a 31-item survey that includes one indicator item and is delivered both at the beginning and end of a semester. The survey will be administered electronically using Qualtrics via a link shared through Mycourses to the students registered for the lab. An IRB for administration of MLLI is already approved through the Human Subjects Research Office given a parallel pedagogy research project. The MLLI employs a slider bars ranging from 0% (Completely Disagree) to 100% (Completely Agree) and both positively worded items and negatively worded items are included.

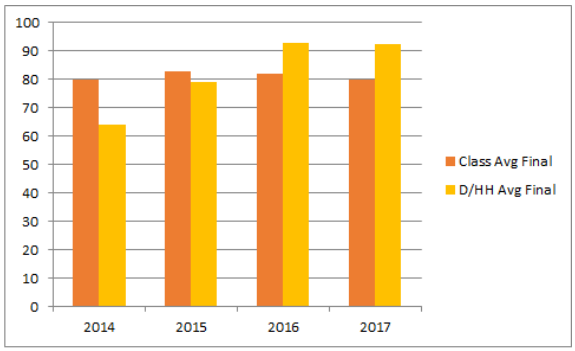
In addition to the MLLI survey data, summative grades for students in the course as they relate to retrieval cues will be studied. To date, preliminary data for the effects of ASL terminology and ASL expansions for mechanistic pathways has been tracked. This data is what inspired our pursuit to incorporate the retrieval cues to *all* students in the course and across all organic sections. Figure 1 demonstrates the promising effects of retrieval cues within the relevant course among the D/HH student population in organic chemistry for non-majors since 2014. Our hope is that the observed increase in averages when compared with historical averages extrapolates to hearing students in the course as well and may extend beyond organic chemistry.

Lastly, the lab instructors in organic chemistry will look closely at one question embedded into each of the first semester lab activities that directly prompts the student to list two concepts from the lecture that are related to the technique they just performed in the lab. Instructor feedback will be collected and evaluated at the end of each semester. Dr. Douglas Tusch will serve as both a developer and link for tracking the retrieval cues in co-requisite lab courses. Dr. Lea Michel is included in this project as a direct link and consultant for the tracking of retrieval cues beyond organic chemistry since she teaches biochemistry, a course for which organic chemistry is a pre-requisite.

Figure 1. (a) Exam 4 averages for the entire class (hearing, n~120 students) in comparison to the exam 4 averages for the D/HH population reliant on an interpreter (n~5-10 students). (b) Final grade averages for the entire class (hearing, n~120 students) in comparison to the final grade averages for the D/HH population reliant on an interpreter (n~5-10 students).



(a)



(b)

Once our revised curriculum has been developed, implemented, and evaluated, our plan is to disseminate our findings internally among RIT faculty. We plan to have directed workshops for faculty whose courses are directly affected by our retrieval cues and also informative sessions to those not directly impacted but nevertheless interested in making analogous changes to their foundational courses. As noted in our budget, it is also our intent to present our findings off-campus specifically at the NERM 2020 meeting held that year in Rochester, NY. We are extremely optimistic about the broad impacts our efforts will have on the RIT students in COS and hope that this project once started will seed future pedagogical endeavors for external funding and peer-reviewed articles.

Citations:

[4] Kelli R. Galloway and Stacey Lowery Bretz, *J. Chem. Educ*. **2015**, 92, 1149−1158

ADDITIONAL CONSIDERATIONS

Please address these questions, if needed.

Will your project require assistance for extensive or unusual media, multimedia, simulation, and/or software development? If so, please explain?

Not applicable

All courses offered by RIT must be accessible to students with disabilities, according to Section 504 of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act of 1990 (rit.edu/studentaffairs/disabilityservices/info). Is your proposed teaching approach accessible to all students, with reasonable accommodation? If not, please explain.

RIT abides by the Family Educational Rights and Privacy Act of 1974 (FERPA), which prohibits instructors from making students' identities, course work, and educational records public without their consent (rit.edu/xVzNE). Will any data gathering or sharing for your project raise any FERPA issues? If so, please explain.

No FERPA issues are foreseen and discussions with Heather Foti in the Human Subjects Research Office has already occurred. The MLLI survey data collected is exempt and IRB approvals to use MLLI have already been obtained. Each student who submits a survey is signing an approved IRB waiver.

DISSEMINATION AGREEMENT

By completing this grant application, I agree to provide the materials and services described here, in support of disseminating what is learned from this project to the RIT community.

I also agree to return all/a portion of the funds that I receive for this project to RIT if I fail to complete or provide the materials described here:

- Full Project Plan (*including roles and responsibilities, milestone dates, and pertinent project details*)
- Preliminary Findings report (*may include experiment/study design, lessons learned, initial data collection, and/or literature review summary*)
- Participation in an ILI/TLS Preliminary Findings Roundtable dissemination event (*share and discuss your preliminary findings with your PLIG cohort*)
- Final Summary of Findings (*including data collection, lessons learned, implications for further study, and which may be in the form of an article abstract, conference presentation outline, or short report*)
- Final budget accounting (*reconciliation of budget provided with your application and the actual project expenses)*
- Participation in an ILI/TLS PLIG Showcase dissemination event (*present a poster or other display at the annual Showcase*)

By submitting this application, I accept this agreement. CG *(applicant, please initial here)*

TIMELINE AND TASKS

Please indicate any variances to the planned PLIG 2019 schedule as described in the above Dissemination Agreement and the reasons for this variance. *If you do not intend to deviate from the schedule, you may leave this section blank.*

Task	Date	Proposed Variance and Reason
Full Project Plan submitted to TLS	August 16, 2019	
Preliminary Findings report submitted to TLS	January 10, 2020	
Participation in an ILI/TLS Preliminary Findings Roundtable dissemination event	February, 2020	
Summary of Final Findings report submitted to TLS	August 21, 2020	
Final Budget Accounting report submitted to TLS	August 21, 2020	
Participation in an ILI/TLS PLIG Showcase dissemination event	November 2020	

DISSEMINATION PLAN (*optional*)

Provide details about the journals, conferences, shows, or other external vehicles with strong potential for dissemination of your results (in addition to the ILI/TLS Preliminary Findings Roundtable and PLIG Showcase dissemination events). Include supporting documentation, such as preliminary interest or acceptance, with your application, if available. *(Please note that special consideration will be given to proposals that have a defined opportunity for external dissemination, such as an academic journal or professional conference.)*

It is our intent to present our work in the Division of Chemical Education at the following meeting:

Northeast Regional Meeting (ACS) 2020 Rochester, NY

RIT

DEPARTMENT HEAD CERTIFICATION

I support this PLIG application and verify that the principal applicant is a full-time faculty member in good standing in my department.

Principal Applicant Name: Christina Goudreau

Department Head Name (PRINT): Paul Craig **Email**: pacsch@rit.edu

Department Head Signature: _____ **Date**: _____

NOTE: When signed, please scan and email with your Application Form to: plig@rit.edu