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. More than 200 RIT faculty projects have received funding since the program was initiated in AY 2000-2001. (Examples of previously funded projects are available at the PLIG website, rit.edu/ili/plig).

The launch of the Innovative Learning Institute (ILI) in 2012, and its charge to assist in the creation of exceptional learning experiences for students, led to an evaluation of PLIG and a revitalization of the program to:

- Better support dissemination of individual faculty learning to the wider faculty population
- Provide funding for the implementation of successful pilot projects
- Integrate funding with Institute priorities
- Support the scholarship of teaching and learning

The 2016 Application Form is found on page 3 of this document.

I. ELIGIBILITY

The principal applicant(s) must be tenured or tenure-track RIT faculty. PLIG 2016 projects can include visiting assistant professors, lecturers, adjunct faculty, staff, students, and other contributors.

II. PLIG TYPES

There are two types of grants—Exploration and Focus Grants—for PLIG 2016. Full details are available at rit.edu/ili/plig.

III. USE OF GRANT FUNDS

Provost's Learning Innovations Grants for 2016 may range from $1,000-$5,000.

Examples of the use of PLIG funds include:

- Course release (reasonable, actual replacement costs for full-time, tenure-track or tenured faculty members removed from teaching)
• Development of new technology-based learning tools and/or environments
• Technologies or equipment required by the project 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

The grant timeline assumes that most recipients will use Summer 2016 to plan and develop their PLIG funded project for delivery or implementation during the Fall 2016 and/or Spring 2017 semester(s). The full timeline is at rit.edu/ili/plig.

V. SELECTION COMMITTEE AND EVALUATION 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)

Details on proposal evaluation and selection committee membership is on the website (rit.edu/ili/plig).

VI. QUESTIONS OR COMMENTS

Please email plig@rit.edu with any questions or comments.
PROVOST’S LEARNING INNOVATIONS GRANTS

2016 APPLICATION

INSTRUCTIONS

Complete this form in its entirety and email it to plig@rit.edu no later than January 27, 2016. Please note to save and rename this document substituting your name (in place of “NAME”) in the file name.

Ask your Department Head to complete the Department Head Certification and return the signed copy along with your application. Note: the signed copy may be scanned and emailed.

If you have any questions about completing this application, please email them to plig@rit.edu or call Michael Starenko at 585-475-5035.

APPLICANT INFORMATION

This application is for a:

☐ FOCUS GRANT
☒ EXPLORATION GRANT

Principal Applicant Name: Viet Quang Le ____________________________________ Email: vqlntm@rit.edu

Faculty Title: Tenure Track Assistant Professor _____________________________ Phone: 585-475-2479

(Full-time, tenured and tenure track only)

College: NTID ___________________________ Department: Science and Mathematics

Department Head name: Matthew Lynn ______________________________ Email: malntm@rit.edu

Proposed Project title: Teaching Molecular Shapes Through Interactive Models to Dead and Hard-of-Hearing Students ___________________________ __________________________

Total funds requested (requests of $1,000 to $5,000 will be considered): $5,000.00

Others involved in the project (if any): Pam Berkeley, Todd Pagano, Annemarie Ross ___________________________ __________________________
BUDGET

There is a fillable PDF worksheet to calculate your budget. You can download the worksheet at rit.edu/plig.

- The total shown on this worksheet must match the “Total funds requested” in the Applicant Information section 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

TIMELINE

Please indicate any variances to the planned PLIG 2016 schedule and your reasons. If you do not intend to deviate from the schedule, you may leave this section blank.

<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
<th>Proposed variance and reason</th>
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</thead>
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<td></td>
</tr>
<tr>
<td>Preliminary findings submitted</td>
<td>Jan. 25, 2017</td>
<td></td>
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<tr>
<td>Summary of final findings submitted</td>
<td>Aug. 23, 2017</td>
<td></td>
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<tr>
<td>Final budget accounting submitted</td>
<td>Aug. 23, 2017</td>
<td></td>
</tr>
<tr>
<td>Faculty Teaching and Learning Commons posting (a summary of findings,</td>
<td>On or before</td>
<td></td>
</tr>
<tr>
<td>examples of teaching designs or materials, etc.) due</td>
<td>Oct. 24, 2017</td>
<td></td>
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<tr>
<td>Participation in Teaching and Learning Services PLIG dissemination</td>
<td>On or before</td>
<td></td>
</tr>
<tr>
<td>event</td>
<td>Nov. 17, 2017</td>
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</table>
STATEMENT OF UTILITY (two pages maximum)

Using the proposal evaluation criteria outlined in the Evaluation section of the website (rit.edu/ili/plig), please provide an overview of the project you are proposing, including:

- Project objectives
- 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 the priority area and/or how this approach has been successfully used at RIT already.

Teaching Molecular Shapes through Interactive Models to Deaf and Hard-of-Hearing Students

1. Goals and Objectives of the proposed project

This proposed project is aimed at using 3D print as an interactive model of Valence Shell Electron Pair Repulsion Theory (VSPER) for deaf and hard-of-hearing students to predict the geometry and molecular shapes of simple molecules. Specifically, this study aims to: (a) assess deaf /hard-of-hearing student’s learning through abstract and concrete approaches; (b) measure the effect of 3D print on deaf/hard-of-hearing student’s understanding of the VSPER theory.

The full term of the project will be one year starting in Fall 2016 that will take place in the Principles of Organic course (NLST 230) under the Laboratory Science and Technology (LST) program at NTID. This pilot study will collect data for publication toward the peer-reviewed journal.

2. Statement of the Problem

Molecule is created by atoms that are connected to each other through chemical bonds. Lewis-dot structure is a diagram that shows the correct placement of the atoms, bonds, and electrons in a molecule. To accurately predict the molecular geometry, the Valence Shell Electron Pair Repulsion (VSEPR) is used as a system. Therefore, the students use molecular kits such as the classical ball and stick model to build a 3D molecule from the 2D Lewis-dot structure and use VSEPR to determine the molecular geometry. This is an abstract approach that encourages a challenge for deaf and hard-of-hearing students who may not fully understand the concept of the VSEPR if they begin with the diagram approach, Lewis-dot structure. There are two types of approach to student’s learning:

1. Should the deaf and hard-of-hearing students begin with the diagram approach, Lewis-dot structure, and then VSEPR to predict the molecular geometry?
   a. This is an abstract approach that may tempt students to memorize VSEPR geometries and bond angles.

2. Should the deaf and hard-of-hearing students begin with the interactive model and then the diagram approach, Lewis-dot structure, and VSEPR to predict the molecular geometry?
   a. This is a concrete approach that allows students to engage with the interactive model and also provides more opportunities to visualize the molecular shape of a compound.

Deaf and hard-of-hearing students are visual learners. The proposed concrete approach is established in hope that the deaf and hard-of-hearing students will not only rely on information that are presented visually, but engage with it. It may suggest that those students learn new things easier when students are interacting with it. Additionally, there are disadvantages on using Lewis-dot structure and molecular kits.

Although Lewis-dot structure allows student to see the placement of the atoms, bonds, and electrons and to predict the correct number of bonds, cluttered drawing of full Lewis-dot structure is often difficult to determine the
molecular geometry. Especially it is a challenge to visualize the 3D structure from a 2D structure. Therefore, molecular model kits are used to build a 3D model of the molecule. Ball and stick is a classical model that students use to build a molecule. At the same time, the students can rotate the ball (atoms) around sticks (bonds). However, the sticks tend to rotate to unintended positions, when we pick it up to look at it - for big molecules, it is practically impossible to pick it up without distorting it. In addition, the bond angle is predetermined and the ball of different colors is the same size which is often misleading because this model doesn’t show the relative differences in sizes between different atoms.

Although molecular model kits have become reliable in teaching methods for a long time, it creates limitations that they could not explain the complex molecular structure. Introducing a 3D print to replace the classical molecular model kits will provide more accurate and arbitrarily complex structures for students to gain a better understanding of a structure’s form and function.

Traditionally, students are passive learners that quietly take information through presentation, Powerpoint slides, or in-class assignments. They are not physically engage nor directly interact with it. Motivation is an important factor of learning in encouraging students to engage in academic activities. Students want to be able to build their own knowledge and connect to classroom materials on their own. Interactive models are great tools for active learners to recognize the classroom materials. Students can use the interactive models during the presentation to understand how materials presented visually are linked with it. In term of molecular shape, 3D prints as interactive models will allow students to explore the 3D of simple molecular structure. Students can see the difference in sizes, bond angles, and functions around the 3D print of the molecule.

Currently, 3D printing has not made a huge impact in educational institutions because there is a lack of knowledge of the technology by the instructors. Our proposed project may encourage every subject within a school curriculum to benefit from 3D printing technology.

RIT/NTID is the world’s largest technical college for students who are deaf or hard-of-hearing. This project will take place in the Principles of Organic course registered in the Laboratory Science of Technology (LST) program at NTID. This course is offered in the Fall semester for the 2nd year LST students who are pursuing for associate degree.
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 an entirely new paradigm. (Please note that special consideration will be given to proposals that demonstrate a new use/application of a model, system, or technology already in use at RIT.)

Active learning is generally known to produce better learning outcomes than passive learning. Traditional lectures are primarily passive in nature, with student notetaking as the main active component. Deaf and hard-of-hearing students often do not have an opportunity to take notes during a lecture, since they may rely on notetakers and/or may be watching an interpreter or a professor in addition to the board. These students are therefore likely to get fewer active learning opportunities than their hearing counterparts. The innovative aspect of this project will be to replace a traditional lecture with a class format designed to engage the students with a physical model that allows them to construct their knowledge and see the correlation between the model and the theory on their own.

In term of molecular shape, Lewis-dot structure and VSEPR are traditional systems that students use to predict the molecular geometry. However, students do not engage with the molecule which provides a challenge for students to visualize the true geometry. Molecular kits such as the classical ball and stick model allow students to see the 3D shape of the molecule and extend their understanding of the Lewis-dot structure and VSEPR. However, these classic models have fixed options for connecting the sticks that represent electron pairs, which fails to convey the geometry changes that occur as electron pairs are added. 3D printed interactive models will provides a better perspective than the traditional models because it will allow students to observe the geometry changes as electron pairs are added. Additionally, if the 3D printed interactive models are successful at improving educational outcomes, the model plans can be uploaded to an online library for easy and inexpensive distribution and production. This project will not only allow an assessment of the success of the models as educational tools, but it could open up many opportunities to other chemistry-related topics for the deaf and hard-of-hearing students.
STATEMENT OF EFFICACY (two pages maximum)

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

Designation and Roles

The proposed project is designed for the Principles of Organic course under the Laboratory Science and Technology (LST) program at NTID. This course is intended for the 2nd year LST deaf and hard-of-hearing students offered in the fall semester. Dr. Viet Le, Assistant Professor of NTID’s Science and Mathematic, will be the instructor for the Principles of Organic course in Fall 2016. There will be 2 lecture and 2 laboratory sections. The lecture sections are every Tuesday and Thursday at 8:00-9:15 AM and 9:30-10:45 AM. The laboratory sections are every Wednesday at 8:00-10:50 AM and 2:00-4:50 PM. Therefore, the proposed project will take place during the laboratory periods. Dr. Viet Le will be responsible for research design to determine the effective of the 3D print as interactive model for student’s learning.

Dr. Pam Berkeley is a tenure-track Assistant Professor of Engineering Studies Department at NTID. She will be involved with the design of the model for 3D printing and data analysis.

Dr. Todd Pagano, former director of NTID’s LST program, is an Associate Dean for Teaching and Scholarship Excellence at NTID. He will serve as a mentor for this project. He will also share the responsibility for the design of the chemistry structure as the best pedagogical teaching tool.

Annemarie Ross is an Associate Professor of Science and Mathematics Department at NTID. She is a skilled ASL signer who will conduct the in-person interview with the deaf and hard-of-hearing students. She will also be involved with the qualitative analyses.

Research design

To understand the VSEPR theory, a class of simple molecules such as carbon dioxide, water, ammonia, etc will be selected for the purpose of easy prediction of molecular geometry. In the concrete approach, these simple molecules will be created and display as 3D prints to compare with the abstract approach. There will be 2 laboratory sessions during Fall 2016. One section will use the abstract approach while the other section will use the concrete approach.

Methodology

In both laboratory sections, the instructor will begin with the Powerpoint slides to describe the rules for Lewis-dot structure and VSEPR. Students will be given a worksheet of simple molecules to determine the molecular geometry.

Abstract approach:

1. During the laboratory session, students will begin to draw the Lewis-dot structures by assigning the correct placement of atoms, bonds, and electrons in a simple molecule.

2. Once the Lewis-dot structure of a molecule is established, students will use the chart of VSEPR from the classroom textbook to predict the shape and bond angles

Concrete approach:

1. During the laboratory session, students will begin to interact with the 3D prints to understand the structures of simple molecules by looking at the placement of atoms and bonds. 3D prints will be use throughout the activity.
2. Students will draw the Lewis-dot structure by assigning the correct placement of atoms, bonds, and electrons in a simple molecule.

3. Once the Lewis-dot structure of a molecule is established, students will use the chart of VSEPR from the classroom textbook to predict the shape and bond angles.

*Notice: The VSEPR chart will be taken from the textbook “3rd edition: General, Organic, & Biological Chemistry” by Janice Gorzynski Smith. This textbook is use for the Principles of Organic Course.

At the end of the lab period, students will be interviewed about their experience and understanding of the molecular shapes. The primary goal of this interview is to understand why students assign the molecular geometry of simple molecules on the worksheet.

The Lewis-dot structure and VSEPR worksheets and interviews from both abstract and concrete approaches will be collect for data analysis.

In the next lab section, students will switch to a different approach to experience both abstract and concrete approaches.
DISSEMINATION PLAN (optional)

Provide details about the journal, conference, show, or other external vehicle with strong potential for dissemination of your results. 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.)

ILI will arrange channels for disseminating results within RIT.
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.

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](http://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](http://rit.edu/xVzNE)). Will any data gathering or sharing for your project raise any FERPA issues? If so, please explain.
DISSEMINATION AGREEMENT

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

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)
- Overview of preliminary findings (may include experiment/study design, lessons learned, initial data collection, and/or literature review summary)
- Final project summary (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)
- Teaching and Learning Commons posting (a summary of findings and examples of teaching designs or materials)
- Participation in a faculty dissemination event
- Final budget accounting (reconciliation of budget provided with your application and the actual project expenses)

By submitting this application, I accept this agreement. VL (Applicants initials)
DEPARTMENT HEAD CERTIFICATION

I support this PLIG application and budget, and verify that the principal applicant ____________________ is a full-time, tenured or tenure-track faculty member in good standing in my department.

Department Head Name (PRINT): ___________________________________ Email: __________________

Department Head Signature: ________________________________ Date: ______________
DEPARTMENT HEAD CERTIFICATION

I support this PLIG application and budget, and verify that the principal applicant Viet Q. Le is a full-time, tenured or tenure-track faculty member in good standing in my department.

Department Head Name (PRINT): Matthew A. Gum

Email: MGLNTME@RIT.EDU

Department Head Signature: [Signature]

Date: 2/5/2016
# PLIG Budget Worksheet

**Applicant's Name:** Viet Quang Le

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<th>Purpose/Justification</th>
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<td>Adjuncts, Part-Time Faculty/Staff, Summer Salary</td>
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<td>Student Workers, Graduate Assistants</td>
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Personnel Total $0

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Equipment Total $2,500

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<tr>
<td>2 Travel to conference</td>
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Travel Total $2,500

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Other Expenses Total $0

**Total Award Request** $5,000