SOCIETY OF PHYSICS STUDENTS
An organization of the American Institute of Physics

Marsh W. White Award Proposal

Project Proposal Title	Visualizing Physics (VisPhys)
Name of School	University of North Carolina at Chapel Hill
SPS Chapter Number	#4847
Total Amount Requested	$500.00

Abstract

VisPhys is an initiative dedicated to enhancing concept retention, comprehension, and the development of physical and mathematical intuition for physics students at UNC-CH and the broader student community in Chapel Hill, particularly high school students. Our goal is to foster deeper passion for physics through a series of engaging workshops.

Proposal Statement

Overview of Proposed Project/Activity/Event

Brief Description:
VisPhys will consist of a series of workshops designed to provide students with hands-on experiences, collaborative learning opportunities, and conceptual exploration in the field of physics. These workshops will feature collaborative group projects, physics demonstrations, and conceptual think-tanks.

Project Goals:
1. Enhance Concept Retention: Improve the retention of physics concepts among participants through interactive and collaborative learning experiences.
2. Foster Comprehension: Facilitate a deeper comprehension of physics principles, with a focus on mechanics, relativity, and electromagnetism.
3. Develop Physical and Mathematical Intuition: Cultivate students' intuition for physical phenomena and strengthen their mathematical reasoning skills essential to pursuing an undergraduate physics degree.

Intended Audience:
The primary target audience includes physics students at UNC-CH and Orange County, with a specific focus on improving the learning experience for students in introductory physics courses. The project extends its reach to the general student community in Chapel Hill, including high school students, providing them with a unique opportunity to explore and appreciate physics in an interactive and collaborative setting.

Background and Motivation:
The foundation of VisPhys is rooted in empirical evidence and research findings within the field of physics education. Several studies have highlighted the challenges that students often encounter in grasping abstract physics concepts, emphasizing the importance of innovative pedagogical approaches to enhance learning outcomes. This initiative draws inspiration from the success of prior collaborative projects undertaken by our chapter, aligning with the recommendations and outcomes documented in literature. The work of Hake (1998) and Redish (2003) underscore the significance of active engagement and collaborative learning in improving students' conceptual understanding of physics. The positive impact of interactive, hands-on activities on concept retention and comprehension has been well-documented in studies by Deslauriers et al. (2011) and Crouch and Mazur (2001).

Moreover, the motivation for VisPhys is grounded in a commitment to addressing the limitations of traditional lecture-based teaching methods. Freeman et al. (2014) and Wieman and Perkins (2005) emphasized the need for transformative educational environments that prioritize student collaboration, critical thinking, and conceptual exploration. Our chapter's demonstrated success in previous physics-related initiatives provides a solid foundation for the VisPhys project. Drawing upon research-backed methodologies and insights from physics education, our dedicated team of organizers and educators is well-equipped to implement effective strategies that align with the best practices identified in scholarly literature. The conception of VisPhys is informed by a growing body of research recognizing the pivotal role of community and collaboration in fostering meaningful learning experiences in physics, particularly for introductory students. Studies by Freeman et al. (2007) and

Smith et al. (2009) have highlighted the positive impact of community-building activities on student success and satisfaction in STEM fields.

References:
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How Proposed Activity Promotes Interest in Physics

The VisPhys initiative is specifically tailored to meet the criteria of the Marsh W. White Award, providing a comprehensive program designed to enhance the appreciation and interest in physics. Through a series of workshops, collaborative projects, and physics demonstrations, VisPhys seeks to captivate the curiosity of students at UNC-CH and the broader Chapel Hill community, including high school students. VisPhys caters to a diverse audience, including undergraduate physics students, high school students, and the general student community in Chapel Hill. This inclusivity aligns with the Marsh W. White Award's goal of promoting interest in physics among both students and the broader public.

Specifically, the project's emphasis on collaborative group projects, hands-on physics demonstrations, and conceptual think-tanks fosters an interactive learning environment. This aligns with the award's objective to support activities that actively engage participants in physics-related experiences. Our chapter's track record in implementing successful physics-related projects demonstrates our capability to effectively execute VisPhys. We build on the success of the UNC-CH SPS K12 Educational Outreach program (SPSEO), a tutoring service offered by our chapter, ensuring a high-quality and impactful experience for participants. The project is led by dedicated members of the 2023-2024 Executive Board, including this initiative's director and that of SPSEO, Jasmine Elmrabti, who are active members of the SPS national organization. Thus the initiative represents an ideal candidate for the Marsh W. White Award, embodying the spirit of Dr. Marsh W. White's commitment to advancing physics education and engagement.

Plan for Carrying Out Proposed Project/Activity/Event

Personnel:

- Project Leaders: Two experienced SPS Board members–Jasmine Elmrabti and one other member in service–will serve as project leaders, overseeing the planning and execution of VisPhys. Their roles include coordinating workshops, managing logistics, and ensuring adherence to timelines.
- Event Organizers: The SPS 2023-2024 Executive Board and a team of volunteers will assist in organizing specific components of VisPhys, including collaborative projects, physics demonstrations, and conceptual think-tanks.
- Progress Monitoring: Regular progress meetings will be scheduled, led by project leaders, to assess the development of workshop materials, participant engagement strategies, and logistical arrangements. A shared project management platform will facilitate real-time collaboration among team members.

Marketing:

- Digital Platforms: VisPhys will be promoted through the chapter's social media channels, primarily Instagram, reaching a wide audience. Engaging visuals, teasers, and highlights of planned activities will be shared by the Communications Director, Ashleigh Smith, to generate interest.
- Campus Announcements: Strategic announcements will be made on the UNC-CH Department of Physics and Astronomy bulletin boards, newsletters, and through relevant academic departments to capture the attention of both physics students and the broader student community.
- Collaboration with Student Organizations: Partnerships with related student organizations, science clubs, and academic societies will be formed to expand outreach. These collaborations will involve cross-promotion and joint marketing efforts.

SPS Member Participation:

- Workshop Facilitators: SPS members will play a vital role as facilitators during workshops, guiding participants through collaborative projects, experiments, and conceptual discussions. A collection of additional SPS volunteers have already been identified and will assist in setting up and managing workshop spaces, ensuring a smooth flow of activities.
- Recruitment: SPS members will actively recruit additional volunteers from within the chapter, emphasizing the value of hands-on involvement in promoting physics education. A tiered volunteer structure will be established to accommodate varying levels of commitment.

Expertise:

- Faculty Involvement: Engaging physics faculty members will contribute their expertise through guest lectures, participation in think-tanks, and mentorship opportunities.
- External Experts: Collaborations with physics education researchers within the UNC-CH physics department will provide diverse perspectives and enrich the learning experience.
- Training Workshops: Specialized training workshops for SPS members will be conducted to ensure they are well-equipped to lead activities effectively. This may involve inviting external experts or utilizing the expertise within the chapter.

Project/Activity/Event Timeline

1. **November 15 - December 1: Leadership and Organizational Preparation**
- Confirm Executive Board members' roles and responsibilities for leading the VisPhys project.
- Schedule initial planning meetings to discuss the vision, goals, and division of tasks.
- Identify and contact potential faculty or external experts for collaboration.
- Establish communication channels for the project team.

2. **December 2 - December 15: Workshop Agenda Drafting and Resource Planning**
- Brainstorm and draft workshop agendas for each of a minimum of eight planned events.
- Compile a list of required materials and resources for each workshop.
- Initiate the procurement process for necessary materials, ensuring timely delivery.

3. **December 16 - December 31: Leadership Training and Extra Volunteer Recruitment**
- Conduct a brief training session for Executive Board members to align on project goals and responsibilities.
- Initiate recruitment efforts for additional volunteers, emphasizing the unique aspects and benefits of participating in VisPhys.
- Continue refining workshop agendas based on initial input from the leadership team.

4. **January 1 - January 15: Finalize Workshop Agendas and Marketing Kickoff**
- Finalize workshop agendas based on feedback from the leadership team and potential collaborators.
- Launch a marketing campaign to generate interest among the target audience.
- Continue volunteer recruitment and emphasize the value of participating in multiple events.
- Conduct a second training session for volunteers and leaders, covering specific details for each workshop.

5. **January 16 - February 1: Workshop Logistics and Participant Recruitment**
- Confirm workshop locations, technical requirements, and any collaborations with faculty or external experts.
- Intensify participant recruitment efforts through targeted outreach, including on-campus tabling promotions or collaborations with student groups.

6. **February 2 - February 28: Execute Spring Workshops (Events 1-3)***
- Launch and execute the first VisPhys event, focusing on visualizing Lorentz transformations with a group construction of the spacetime globe.
- Continuously monitor participant engagement and gather feedback for immediate improvements.
- Sequentially execute the remaining two workshops for the month, focusing on subjects building from relativity, coordinate systems, and Newtonian mechanics, highlighting Galilean transformations.
- Document each event with photos and participant testimonials for future promotional efforts.
- Express appreciation to volunteers, collaborators, and participants for their contributions after each event.

7. **March 1 - March 30: Execute Spring Workshops (Events 4-6)***
- Execute sessions 4-6, this month focusing on the wave model and electrostatics, with the prescribed agendas and procedures outlined in steps 1-6. Workshop activities for these sessions include electric circuit/toy construction, wave interference demonstrations (e.g., with a wave tank), and “Gedankenexperiments” and a water model of geometry to visualize the Pythagorean theorem and its relation to physics problems.

8. **April 1 - April 30: Execute Spring Workshops (Events 7-8)***

- Execute sessions 7-8, this month focusing on the nature of magnetism with the prescribed agendas and procedures outlined in steps 1-6. Workshop activities for these sessions include ferrofluid arts and crafts.

**Note that the SPS Executive Board reserves the right to modify session plans and/or instruction depending on the needs of the community and/or unpredicted price fluctuations for related materials.*

Activity Evaluation Plan

The success of the VisPhys project in promoting interest in physics will be evaluated through a multi-faceted approach, combining quantitative metrics and qualitative feedback.

1. Attendance/Participation Numbers:
   - Keep detailed records of the number of participants attending each workshop.
   - Track the diversity of participants, including undergraduate physics students, high school students, and members of the general student community.
2. Participant Surveys:
   - Administer short Google Forms surveys to participants at the conclusion of each workshop, gauging their level of interest in physics before and after the event, including questions about the effectiveness of workshop content, the clarity of explanations, and the overall impact on their perception of physics.
   - Add optional responses for school name, age, grade, race/ethnicity, and residence region of each participant to gain a better understanding of demographic participation, so we can better cater to diverse populations.
   - Utilize Likert scales and open-ended questions to gather both quantitative and qualitative data.
3. Feedback from Volunteers and External Collaborators:
   - Collect feedback from volunteers regarding their experience in organizing and facilitating the workshops.
   - Seek input from external collaborators, such as faculty or guest speakers, on the effectiveness of the workshops in achieving the goal of promoting interest in physics.
4. Analysis and Reporting:
   - Compile survey responses and feedback into a comprehensive report using Google Sheets for quantitative analysis.
   - Summarize key findings, including trends in participant responses, areas of improvement, and notable success stories.
   - Use the compiled data to assess the overall success of the VisPhys project in promoting interest in physics.

By using Google Forms for participant surveys and Google Sheets for data analysis, we ensure a streamlined and efficient evaluation process. The use of these tools allows for real-time tracking and easy data aggregation among the project leaders and evaluators. The insights gained from this evaluation plan will inform future iterations of the VisPhys project, ensuring a sustained impact on fostering interest in physics within our community.

Budget Justification

The proposed budget serves as a strategic investment in the success of VisPhys, designed to enhance physics education and foster a sense of community amongst physics students. Each expense has been carefully considered to contribute directly to the project's goals and align with the objectives of the Marsh W. White Award. The purchase of volunteer T-shirts is crucial for creating a cohesive and professional team identity. These T-shirts will not only serve as practical and comfortable uniforms for volunteers but also contribute to a unified and collaborative atmosphere, fostering a sense of belonging and pride within the team. Funds allocated for session materials directly support the hands-on workshops integral to the VisPhys project. For example, the Spacetime Globe materials will enable the manual construction or use of UNC-CH Makerspace for 3D printing, providing students with a tangible and interactive experience of Newtonian mechanics and relativity concepts. Similarly, the Electrostatics and Wave Model materials will facilitate the construction of a Pythagorean theorem water model, enhancing understanding and retention of problem-solving strategies. The budget for Ferrofluid Art materials ensures the creation of engaging sessions on magnetism.

Food and beverages serve as essential components of successful events, fostering a convivial atmosphere and encouraging participation. This allocation ensures that participants and volunteers are provided with refreshments, contributing to a positive learning environment. The modest budget for gas is dedicated to covering transportation costs associated with the purchase and retrieval of materials, allowing us to acquire quality materials efficiently.

Lastly, we account for in-kind support, such as borrowed equipment and communal kitchen storage for non-alcoholic beverages, maximizing the impact of the allocated budget. The proposed budget reflects a balance between essential resources and cost-effective measures to ensure the successful execution of the VisPhys project, supporting the project's goals of promoting interest in physics.