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CourseSource

Lesson

Discovery Poster Project

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Abstract

Engaging in undergraduate research can be exciting yet intimidating to first-year students at large research universities. For first-generation college students, whose pre-college exposure to research may be limited compared to their continuing generation peers, undergraduate research can be particularly intimidating. The Biological Discoveries Poster Project is designed to introduce students to research and guide their identification and exploration of potentially interesting active research areas. Students utilize popular science media to find recent biological discoveries and explore the topic in greater depth as they learn to use library resources and read primary literature. In addition to developing these skills, students also find a local research team working in the same area and interview the faculty leader of that team about their research. Students synthesize what they learned about their research topic in a scientific poster and present it to the class at the end of the semester. The Biological Discoveries Poster Project gives students the opportunity to identify research they are interested in, explore research that is being conducted on their campus, and speak to faculty members who share similar interests. Finding a common interest and overcoming the first hurdle of speaking to a faculty member can help lower the barriers to engaging in undergraduate research.

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Supporting Materials: S1 – Discovery Poster Project: Poster Project Packet, S2 – Discovery Poster Project: Poster Template, S3 – Discovery Poster Project: Poster Workshop Feedback Form, S4 – Discovery Poster Project: Poster Presentation Reviewer Form, and S5 – Discovery Poster Project: Group Evaluation Form.

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Learning Goal(s)

Students will:

- develop an understanding of how biology research is conducted
- develop an understanding of the social relevance of scientific research
- develop an understanding of how to engage in research
- develop confidence and skill in communicating with active researchers

Learning Objective(s)

Students will be able to:

- identify and learn about a scientific research discovery of interest to them using popular press articles and the primary literature
- find a group on campus doing research that aligns with their interests and communicate with the faculty leader of that group
- create and present a poster that synthesizes their knowledge of the research beyond the discovery

INTRODUCTION

Learning about research through primary and secondary articles and actually participating in research are important steps to becoming a scientist, and have been shown to generate positive learning outcomes for students (1-4). The Discovery Poster Project teaches students to identify and read research articles about a research discovery of interest. The project includes multiple assignments over the course of the semester and culminates in a scientific poster session at which students present their discovery to their classmates and invited guest scientists.

The Discovery Poster Project is implemented in the Exploring Biology course, which is designed to support students as they learn to navigate the complex academic structure of a university (5). Course goals include easing student transitions to college, preparing them for academic success in biology courses,

developing their college navigation skills, and exploring and planning to engage in co-curricular learning opportunities, including undergraduate research. The course also introduces students to the Vision and Change in Undergraduate Biology Education Five Core Concepts in Biology (Evolution; Systems; Information Flow, Exchange and Storage; Structure and Function; Pathways and Transformations of Energy and Matter), which are the intellectual framework used in the course and the Discovery Poster Project (6). Typically, the Discovery Poster Project contributes 10-15% to the students' final grade in Exploring Biology.

Getting Involved in Research

Rewarding research experiences inspire undergraduate students to pursue careers in science (see 7 for comprehensive review) and have been particularly effective at recruiting members of racial minorities into science (8-9). Research experiences early in a student's career are recommended as the most effective (10-13). Simply introducing students to the process of research and engaging them in thinking like scientists early can have tangible positive impacts (14-15). However, it can be challenging for first-year students, especially at a large research university, to explore areas of research and find potential research mentors (10). The Discovery Poster Project provides a structured introduction to research in the discipline and begins to build skills that students need to get involved in research.

Intended Audience

The intended audience for the Discovery Poster Project is first-year college students interested in pursuing a degree in the biological sciences at a large research university. Though students from underrepresented and traditionally underprepared populations are encouraged to enroll in the course, it is open to all students. Consequently, the demographics of the class (85-90% majority students) reflect those of the university and the college-readiness of these students spans a large spectrum.

Required Learning Time

The Discovery Poster Project is divided into four parts that are completed over the course of the semester. The Project culminates in students presenting their posters to an audience of classmates, instructors and invited guest scientists. Much of the work is completed out of class, though there are several times when students work in class to give one another feedback on assignments and draft products.

Pre-requisite Student Knowledge

No specific prerequisite content knowledge is needed. Students use the knowledge of the Five Core Concepts (6) learned in the course, to complete the project and develop other skills, such as searching for research articles, as part of individual assignments.

Pre-requisite Teacher Knowledge

Instructors need to understand the Five Core Concepts in Biology (6) and the research process. In addition, they need to be familiar with the research conducted on their campus in order to determine whether the project can be focused on their institution or should be broadened to include other institutions.

SCIENTIFIC TEACHING THEMES

Active learning

Students explore and investigate scientific discoveries they find interesting, then self-direct their learning about the topic using library resources/tools and databases to search for primary literature. Students identify faculty researchers on campus with expertise on their topic to interview, perform those interviews, and synthesize the information into a poster. Peer feedback is part of the poster development process and the project culminates in a poster fair where students present their final posters and do peer evaluations of one another's posters.

Assessment

Each assignment within the project is graded (formative assessment) and contributes to the development of the final poster. Grading of the final digital poster and presentation at the end of the semester are the summative assessment, which includes evaluation by peers, guest scientists and the course instructors. Students are provided rubrics for each component to guide development and self-assess their products.

Inclusive teaching

The Discovery Poster Project allows students to explore current research of interest to them and important issues related to the biological sciences. Student interests and ownership encourage the representation of a broad range of topics. The variety of "experts" who are interviewed and profiled in the posters yields a collection of scientists, with diverse backgrounds, and career paths. The diversity of the scientists is limited, however, by the diversity of those available on campus or broader area identified by the instructor. Development and presentation of a poster encourages students to creatively engage with their topics.

LESSON PLAN

The Discovery Poster Project was developed for a two-credit first-year seminar (Exploring Biology) that meets once per week for two hours in a 15-week semester (5). The course serves 100-120 students with a team of 3-5 instructors and a similar number of undergraduate peer leaders. Though the course is not required, most life science majors take a first-year seminar, and many choose one that is discipline-specific. The course is taught in a SCALE-UP (16) style active learning classroom (http://www.wiscel.wisc.edu/), with students seated at tables of six, where each student has access to a laptop and each pod has its own LCD display. Many aspects of the classroom components of the project require at least one student in a group to have a laptop with them in class. If teaching in a classroom without computers, students need to be reminded to bring a laptop to the sessions indicated in the lesson plan. These situational factors drive many of the decisions about the pre-semester questions and have also influenced the structure of the lesson plan that follows. A table of the assignment timeline is included (Table 1).

Pre-Semester Preparation

Specific project parameters are determined by the answers to a few questions about logistics and goals. Our answers to the

questions are included here, but other options are addressed in the Discussion.

- **Will the project be an individual or group project? If it is a group project, how will groups be formed?** Groups of three students are formed by random pod seating assignments made the day before classes begin to limit the impact of last-minute enrollment changes. Students meet their group members on the first day of class. The groups are numbered to aid in referencing them later.
- **Will the poster be printed or electronic? And, how will it be presented?** Each table in our classroom has a television monitor on which posters are displayed. However, a poster template is used to generate these files and can be used to print instead.
- **How will the "Discovery" be defined or limited? And, will students connect that to research on campus?** Students must choose a scientific topic or discovery that has been in the news recently, but that topic is not restricted to the direct work of campus researchers. Regardless of the specific topic, students must find relatively recent research articles and connect their topic to research happening on campus for the interviews.
- **Will library staff be involved in the library session, or will it be done by course instructors?** We partner with a team of librarians to plan and schedule instruction on how to search for and evaluate primary literature.
- **Will I need peer leaders to implement the project?** Peer leaders support course instructors by providing formative and supportive feedback to students as they complete components of the project. They answer simple questions and facilitate in-class discussions, but do not grade student work. Though not necessary to implement the Discovery Poster Project, peer leaders make implementation in large classes more feasible.

Part 1 - Finding a Discovery - Weeks 1-2

Students explore recent science news, through popular media sources to identify a discovery of interest to them.

Class Session 1 and Homework

The Project Packet (Supporting File S1: Discovery Project Packet) is posted to the course learning management system (LMS). The instructor directs students to these documents online and explains the overall goals of the assignment and instructions for Part 1, with a focus on the homework. A sampling of potential websites for finding recent science news stories are included on Page 2 of the Project Packet (Supporting File S1: Discovery Project Packet - Part 1).

During class, students are randomly assigned to groups (and group numbers), provided ~5-10 minutes to get to know one another and discuss their initial ideas for the project. Each group is instructed to exchange contact information and encouraged to set up a place for sharing materials electronically (for example a shared folder in Google Drive or Box).

Outside of class, each student searches the popular media for three recent science related news items and submits them in a single document including the title, URL, citation, and one sentence on why each topic is interesting to them. The individual topic lists should be compiled into a single document before class session two where they will be used for the group brainstorming session.

Class Session 2 and Homework

During class in week two, students work in groups to brainstorm poster topics by sharing the individual topics they selected as part of their homework. Groups may also generate new ideas from searches they do during class. Each group selects two topics they would like to pursue for the poster, which allows flexibility when trying to prevent single topic areas from being over-represented in the class. If there is time, groups also begin drafting short paragraphs explaining their interest in each topic.

By midnight the following day, groups submit their two preferred topic choices, the APA citation for each media source, and a short paragraph for each topic explaining their choices. If the group prefers one topic, they are encouraged to indicate so - though, it does not guarantee that their preferred topic will be selected. The document also includes each group member's individual topic lists (the first assignment).

Before class session three, groups are notified of the topic they will be researching for their poster and provided feedback to guide them on their next steps (e.g., narrowing or broadening their topic, specific sources of information or articles they may wish to explore). The grading key for Part 1 is included in the Project Packet (Supporting File S1: Discovery Project Packet - Part 1). We create a spreadsheet to organize the topics submitted by all groups in order to easily see and then minimize overlap when making project topic assignments.

Part 2 - Library Session & Micropaper - Weeks 3-4

Each group searches the scientific literature for research articles relevant to their topic. Articles identified through these literature searches (Supporting File S1: Discovery Project Packet - Part 2A & B) provide the foundation for writing a short essay (the micropaper) on the topic. Groups are provided resources to help them learn to effectively read scientific articles. Examples include:

- https://ncu.libguides.com/researchprocess/readingscientificarticle
- http://www.sciencemag.org/careers/2016/03/how-seriously-read-scientific-paper
- http://blogs.lse.ac.uk/impactofsocialsciences/2016/05/09/how-to-read-and-understand-a-scientific-paper-a-guide-for-non-scientists/

Class Session 3 - Interactive Literature Search and Resources Demonstration

The library session includes an interactive lecture introducing students to library resources and databases, followed by guided work time for each group to search for primary research articles on their topic. The library class session was developed in partnership with campus librarians, who co-instruct the session. The librarians introduce themselves and the various campus resources available to students for doing research, including electronic resources and workshops, as well as various library locations.

Although students enrolled in the course will largely be reading biological sciences research papers, the librarians introduce students to research articles on a single topic (e.g. surgical outcomes) published in different fields (e.g. a biomedical paper, a social science paper, and a history paper) to illustrate how they can be formatted differently and take different approaches to the same/similar topic.

The librarians provide an overview of various databases and tools available to search for research articles. The class is asked to provide a potential search topic, and the students each pull up one search tool. The students and librarians all perform searches using different search tools and strings and discuss the differing results. The librarians guide the entire class through refining a search using a single search tool, keeping them engaged and giving them hands on experience. These searches also provide an opportunity to show students how to find free full text versions of research articles and request articles that are not available online. The library class session requires access to computers.

After becoming familiar with the various tools and resources available to them, groups begin searching for research articles on their discovery topic. They are given approximately 15-20 minutes to search, and any articles they think will be useful are downloaded to their shared project folder. The micropaper (see below) requires a minimum of two primary research article sources and two secondary sources (either popular media or scientific review articles). While groups are searching, and before work time ends, instructors and peer leaders check in with individual groups to assess their progress, help with any difficulties, and provide feedback and suggestions. Resources on reading scientific research papers are provided via the course LMS, and students are strongly encouraged to attend Peer Leader and/or instructor office hours for help. At the end of class session three, the instructor introduces strategies to use when searching for research on campus that is related to the discovery topic.

Outside of Class - Micropaper

Before students leave class, the micropaper assignment is introduced, which is a collaboratively written, short 300-500-word essay on the discovery topic. The essay addresses the background biology needed to understand the topic, how other disciplines (i.e. math, physical or social sciences) contribute to their understanding of the topic, significance of the topic to society, and connections to at least two of the Five Core Concepts from Vision and Change (6). The micropaper should draw on information included in the journal articles as well as any popular media sources. Full instructions and the grading rubric are included in the Project Packet (Supporting File S1: Discovery Project Packet - Part 2B). If the micropaper is a group assignment, then it is important to emphasize to students that the essay is written collaboratively, and it should be a true collaboration. Instructors can have students write the paper as a shared online document (such as Google Docs) to monitor individual contributions and have the students evaluate their peers and their own contributions during the project group evaluations (Supporting File S5: Group Evaluation Form). The micropaper essay is due by the following class period and is submitted online as a Word document via the LMS.

Part 3 - Expert Interviews - Weeks 5-7

Once students have a basic understanding of their topic, they identify researchers on campus working in the field. If there are no researchers investigating their specific topic, then students simply look for someone with enough expertise to help them understand their topic more deeply.

Outside of Class - Expert Selection and Contact Plan

During the third class session, instructors briefly introduce the resources and strategies for exploring research on campus. Groups work outside of class to find faculty members on campus working on their topic, or in the basic field. Each group develops a short-list of four potential experts who they would like to contact, including a link to webpages that describes the expert's research and a sentence or two on why they would like to contact the researcher. The group also develops a draft email (see Supporting File S1: Discovery Project Packet - Part 3A for email guidance) to contact their experts. The short-list and draft email are submitted electronically to the course LMS.

Instructors provide feedback to the group on both the researchers that they are considering and the content and structure of their email. In this way instructors can track which researchers are being contacted and ensure that one is not inundated with requests in a particular semester (or if that is unavoidable, the instructors can ask that faculty member how many groups they are willing to meet).

Outside of Class - Expert Interviews

After getting feedback on their experts and emails, groups send the interview request. A single group member should send the email requests (from their university email address), but all group members and instructors should be copied on the email. The expert should be encouraged to "reply all" so that everyone can be kept in the loop on the progression and status of the interviews. Students often have difficulty getting responses from faculty members and instructors can intervene and/or provide help as needed. The instructors need to be proactive about monitoring the process, including reminding students in class on a weekly basis.

Interviews are scheduled at the expert's earliest convenience, but students need to indicate a latest possible time in their request (we suggest at least a week before the due date). It is expected that the interview will be done face-to-face, and that as many group members as possible will participate. Students are advised to have one person focus on asking questions and at least one other person take notes. Interviews should last as long as they need to, but it is expected that they will take approximately 15-30 minutes.

Following the interview, the group writes and submits a summary of what they learned (200-400 words). The summary and notes are submitted as soon as the interview is complete. The rubric for the interview summary assignment is in the Project Packet (Supporting File S1: Discovery Project Packet - Part 3B).

Following the interview, groups send researchers a thank you card or email and invite them to attend the poster fair at the end of the semester.

Part 4 - Posters - Weeks 8-15

The last part of the project includes the final poster preparation steps and the in-class poster fair.

Outside of Class - Poster Outline

To help students conceptualize the overall format and content of their poster they develop a basic outline of the poster content. The outline creates an opportunity to provide feedback based on the assignment rubric, without detailed content grading. The outline is due during week eight, and feedback should be provided ahead of the poster draft workshop during week 11. The rubric for the final poster is included in the Project Packet (Supporting File S1: Discovery Project Packet - Part 4C).

Class Session 4 - Poster Draft Workshop

During week 11 groups bring a draft of their poster (more than just the outline) and present it to another group for feedback. All students receive a poster template to help guide their initial poster construction (Supporting File S2: Poster Template). During the workshop, reviewers use a feedback form outlining the important components of the poster (Supporting File S3: Workshop Feedback Form). Groups should present their posters to one another, not just exchange files. Instructors and peer leaders circulate to ensure that posters are being presented and feedback provided. The peer feedback time should take approximately 10 minutes per group for a total of 20 minutes.

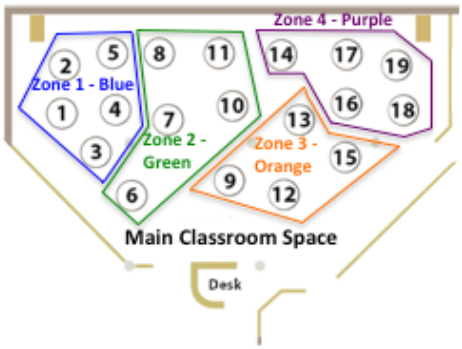
After the initial feedback, groups have another 15-20 minutes in class to refine their posters. While they are refining their posters, instructors and peer leaders consult with each group and provide additional feedback. Draft posters are due at the end of week 11. The draft poster is graded for completion and feedback is provided.

Class Session 5 - Poster Fair

The poster fair takes place during the last class session of the semester, and each member of a group presents the poster individually. When students are not presenting, they review other groups' presentations. The poster fair lasts the entire two-hour class period and is divided into two 45-minute sessions, with time at the beginning to get everyone organized and a break in the middle.

The classroom is divided into color-coded zones (outlined in Figure 1A) and each student is required to view a presentation in each zone during the session in which they are not presenting (Figure 1B). Each table in the classroom is assigned two, three-student groups (Group A and Group B) for their presentations. Students are responsible for bringing electronic versions of their presentations to load on to the computers. During Session 1, each student from Group A spends 15 minutes presenting their poster two or three times for a total of 45 minutes. All other students who are not presenting (i.e. Group B members, and the rest of Group A) serve as audience members for presentations happening in the other zones and complete the Reviewer Form (Supporting File S4: Reviewer Form). Groups A and B swap for Session 2 at each table. Instructions and a reviewer evaluation form are provided to students (Supporting File S4: Reviewer Form). It is not possible for the instructors to view every student giving a presentation, so additional scientists (faculty, staff, and graduate students) are recruited to assess student presentations. They are provided an overview of the course, the learning objectives of the Discovery Poster Project, and instructed to use the review rubric for their assessment. They are assigned to a table for the entire poster fair, where they review six student presentations from two groups. In addition to reviewing, these scientists also encourage classmates in the audience to ask questions, though they do not track who has asked questions.

A



B

	Presenting	Audience (for any presentation)
Session 1 (45min)	Group A-1 (15min)	Group B & Group A -2 & 3
	Group A-2 (15min)	Group B & Group A -1 & 3
	Group A-3 (15min)	Group B & Group A -1 & 2
15 Minute Break		
Session 2 (45min)	Group B-1 (15min)	Group A & Group B -2 & 3
	Group B-2 (15min)	Group A & Group B -1 & 3
	Group B-3 (15min)	Group A & Group B -1 & 2

Figure 1. Room Layout and Presentation Organization. (A) The diagram indicates the layout of the room, with tables numbered. Each table has a dedicated flat screen television monitor on the wall that students can hook into to display their poster electronically (see www.wiscel.wisc.edu for images of the classroom space). Also shown is how the room divided into four zones for the purposes of encouraging audience circulation during presentations. (B) An example of how the two three-person groups from a particular table are scheduled to present and act as audience members during the class period. Groups are designated A and B, while each individual within a group is numbered 1 through 3. During Session 1, members of Group A rotate presenting and during Session 2, members of Group B rotate presenting (Presenting column). When not presenting students act as audience for any presentation occurring at that time, including their groupmates (though they cannot peer evaluate their groupmates).

Project Evaluation & Learning Assessment

Instructors grade the presentations and posters using the rubric included in the Project Packet (Supporting File S1: Discovery Project Packet - Part 4C).

Groupwork Evaluation

After the poster fair, each student evaluates each of their group mates' work and reflects on their own group participation using a group evaluation form (Supporting File S5: Group Evaluation Form).

TEACHING DISCUSSION

The Discovery Poster Project aims to help students develop an understanding of how biology research is conducted, learn how to get involved in research and understand the social relevance of research. Students are guided through a series of assignments in which they identify, explore and ultimately present to their instructors and peers a biological discovery of interest to them. Along the way they learn strategies and make connections with scientists across campus and develop skills to help lower barriers to getting involved in research on campus.

Effectiveness

The Discovery Poster Project lesson plan synthesizes several iterations of implementation to generate a comprehensive project description using the components that we have found to be most effective. Here we discuss some data relevant to the efficacy of the Discovery Poster Project from a larger evaluation of the course in which it is implemented. The evaluation (5), was a cross-sectional study that reviewed course evaluations and surveyed former students of the course.

In the course evaluations, we asked students to rate the helpfulness of the poster project directly and to rate their confidence in achieving some of the learning goals and objectives related to the project (5). According to the course evaluations, 80% of students found the project helpful. Additionally, 82% responded that they were somewhat confident or confident in gaining awareness of how biology research contributes to society and having learned of career opportunities in the biological sciences, 77% responded similarly to being able to find and integrate biology co-curricular learning experiences, such as undergraduate research, into an academic plan, and 54% were somewhat confident or confident in their ability to write and speak like a biologist.

In a survey to course alumni, we asked them to write what was the most valuable thing they took from the course. Five students (5%) specifically identified the poster project and that they liked learning how to make a poster (e.g. "learning how to make and present posters"). We also identified 4 other poster project learning goals and objectives in student responses. Students mentioned developing relationships with active researchers (7%; e.g. "talking to profs [sic]"), understanding the social relevance of research (2%; e. g. "...biology can be applied to daily life"), finding a research group on campus (2%; e.g. "exposure to science on campus"). We were also excited to see that students mentioned getting involved in research experiences (e.g. "seek out independent research), and in two cases, students specifically described how the faculty interaction lowered the barrier to engaging in research:

- "My position at a lab that I received by talking to my mentor"
- "Meeting my TA who got me involved in research"

We also asked students directly if they plan to participate in undergraduate research and 86% responded they will or have already. Importantly, 38% of those students specifically credited our course with helping them get involved.

Defining the Scope of Discoveries

Students can be restricted to particular publication time frames (e.g. papers published within the last year) or particular topic areas. They could be limited to choosing topics based on research happening on campus. Institutions with less research activity may direct students to connect their topics to faculty members who teach courses related to a particular topic or identify researchers at other institutions. Our decision to have students search broadly for a topic of interest allows them to identify areas of interest with little restriction and our requirement to have them connect their topic to research on campus provides the opportunity to meet faculty researchers with whom they may want to work in the future and reduces some of the barriers to getting involved in research. The scope of the discovery topics could also be set to encourage students to choose research done by for example women, early career faculty, or research being done at Historically Black Colleges and Universities and/or Minority serving Institutions.

Creating Posters

Students can print the traditional 36" x 48" format (on campus or at commercial print shops) or print the poster in a tiled format on several letter-sized pages. Students may also develop and post digital presentations to a share site instead of holding an in-class poster fair. To alleviate the financial burden of printing a poster (both on the students and the course) yet retain the in-class poster fair aspect, we decided to use digital posters. Using an active learning classroom gave us access to 19 monitors on which to display posters.

Organizing a Poster Fair

The "poster fair" could occur in the individual small discussion or laboratory sections; however, small groups limits interactions and exposure to a wide array of topics. Doing the poster session with the entire class introduces logistical challenges, but broadens exposure to different research projects. Regardless, it is important to have a plan in place for what students will be doing when they are not actually presenting. Without structure, students frequently failed to engage with their peers. Reducing individual presentation times from 15 to 10 minutes reduces down time and helps keep students engaged.

To Group or not to Group

Individual posters allow students more freedom to explore topics of interest to them and be engaged in all aspects of project development. In large courses like ours, however,

individual posters may not be feasible, for either the presentations or the interviews, making group projects more appealing. Group projects add all of the issues/concerns inherent to group projects, including how to assess each presenter. If we had a smaller class or were willing to remove the interview component of the project, we would return to individual projects.

Defining Experts for Interviews

The definition of "expert" will be based on your specific goals for the project and needs to be explicitly articulated in the Project Packet (Supporting File S1: Discovery Project Packet - Part 3A). In our experience, not clearly explaining this portion of the project led to difficulties for students. An expert can be defined as someone who is doing research on the specific topic at your institution, or at another institution. In these cases, the goals would be related to a student demonstrating an understanding of the research methodology. An expert could also be someone who does research in the broader field or teaches courses in that field. In these cases, the goals would be more about developing a deeper understanding of the biology involved, as opposed to specific research details. In either case, whether the expert had to be on campus or not would be determined by the goals of helping students meet researchers to get involved in research.

Depending on the size of the institution and goals for the assignment, instructors should also monitor and consider pre-screening who the students plan to interview so that specific faculty members are not overwhelmed with requests.

Developing Students' Professional Communication Skills

It is very important that students include an explanation in their interview requests, so that faculty are aware of the expectations (Supporting File S1: Discovery Project Packet - Part 3A). Students can be provided templates for the interview email or a list of important points to remember to include, and/or specific review and feedback on their drafts. We have used guidance with review and feedback, because one of our goals was to help students develop their communication skills. Providing a specific template meant that students were not afforded the opportunity to draft their own email. Regardless of the support strategy selected, it is important that students copy a member of the instructional team on their email to them keep abreast of the interview request process. It is also important that students identify multiple potential faculty members to interview, in case their first choice does not work out.

Conclusion

The Discovery Poster semester project engages students in an authentic learning experience about scientific research. It teaches them to identify and read research articles about a scientific discovery of interest and gives them permission to meet and learn from local researchers with expertise in the field. The project scaffolds multiple assignments over the course of a semester and culminates in a symposium at which students present their discovery to their classmates as a scientific poster. Students report the Discovery Poster Project helps them gain skills and confidence in understanding research and communicating science. These are important first steps in students' efforts to navigate the research environment, especially at large institutions, and in finding and participating in a research experience.

SUPPORTING MATERIALS

- S1 - Discovery Poster Project: Poster Project Packet
- S2 - Discovery Poster Project: Poster Template
- S3 - Discovery Poster Project: Poster Workshop Feedback Form
- S4 - Discovery Poster Project: Poster Presentation Reviewer Form
- S5 - Discovery Poster Project: Group Evaluation Form

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Table 1. Discovery Poster Project - Teaching Timeline

Activity	Description	Estimated Time	Notes
Part 1 - Finding a Discovery - Weeks 1-2			
Poster Topic Identification: Students search for a recent scientific discovery that interests them.	1. Students are assigned to small groups for this project (2-3 students) 2. Students individually search for recent discoveries and come to class with three ideas. These ideas are compiled in a Google Doc (or other shared format) for the group. 3. In Class Brainstorming: Student groups discuss their individual ideas and from this select their Top 2 choices. Each group submits their Top 2 choices, along with a short paragraph for each explaining why they were interested in that topic. Group members also submit their individual topic ideas with this. 4. Provide feedback to groups as to which topic they should pursue.	1. Determined pre-class and announced in class. 5-10 minutes Students should be given time for group introductions. 2. Out of class 3. 15-20 minutes for the groups to discuss. More time if it is desired to give immediate feedback on topics. 4. Out of class	• Students should be assigned to groups and get started on this project within the first few class sessions. • Helpful links for searching for science news stories are included in the project packet (S1). • Selecting two top choices allows flexibility, but ensures a variety of topics are assigned. • Brainstorming Session – Laptop or tablet are helpful. • Feedback should be provided to students before the library session. This feedback can include things like how to tweak a topic to make it more manageable and/or suggest other related ideas. Feedback does not usually refer to specific faculty at this stage. • Project Part 1: Individual topic lists for each group member & the group's Top 2 choices.
Part 2 - Library Session & Micropaper - Weeks 3-4			
Library Session: Librarians & instructors introduce students to searching for journal articles.	1. Interactive introductory lecture on library resources and databases. 2. Guided work time for student groups to search for journal articles on their discovery topic.	1. 10-15 minutes 2. 15-20 minutes	• This doesn't have to use campus librarians, but some of our course goals include not just introducing students to places they can go for help, but the people too. • In the future, we'd like to spend more class time on how to read the papers they find. Currently, we provide resources listed in the lesson plan. • Laptop or tablet is required for at least one person per group.
Micropaper	A short (300-500 word) essay on the topic, including: background biology, significance to society, and involvement of core concepts. Journal articles and popular press articles should be cited.	Out of class	• We've done this both as an individual assignment (within the group project) and a collaborative essay depending on your grading capacity. Pro's/Con's for each option (described in Discussion). • Project Part 2: micropaper essay
Part 3 - Campus Research, Experts Identification, and Expert Interview - Weeks 5-7			
Campus Research and Experts Identification	1. Groups utilize campus research portals to identify at least four faculty members working in the field related to their discovery and include a sentence describing why each is related to the topic. (Submitted to instructors) 2. Groups compose draft emails to faculty (Submitted to instructors) 3. Instructors meet with each group to discuss/steer which 2 faculty members they should contact initially and provide feedback on the email draft.	1. Out of class 2. Out of class 3. 5-10 min/group	• **Project Part 3A:** (1 & 2) Potential faculty list and draft email • Can be done via email/LMS and/or out of class. • Group Meetings with Instructors: The instructional team is large enough to meet with half of the groups at a time. The other half work on their projects while waiting.
Expert Interviews	1. Groups email two faculty members to request an interview. Ideally, interviews will be in person but phone is acceptable. 2. Groups interview faculty member(s) (one is required, two is great). 3. Groups submit a copy of their notes and a summary of the interview (200-400 words). 4. Groups send thank you notes & poster session invitations.	1. Out of class 2. Out of class - Interviews should take 15-30min 3. Out of class 4. Out of class	• Email should be sent by a single group member, but all group members and instructors should be copied • All group members should participate in the interview. • Only one interview has to be done per group. • **Project Part 3B:** interview notes & summary • Students should send Thank You cards and invite the faculty member to the poster session. These can be pre-prepared and provided to them.

Activity	Description	Estimated Time	Notes
Part 4 - Posters - Weeks 8-15			
Poster Outline	A bullet point list of the poster content and how information will be organized. Can include blank spaces where specific information is still to be determined. Submitted for feedback.	Out of class	• **Project Part 4:** Outline with the main content included. • Students will need feedback on this for the poster draft workshop.
Poster Practice Presentation & Workshop	1. Groups bring their draft posters to class and present them to another group for feedback. 2. Work time: Groups revise posters based on the peer feedback they receive. 3. Submit revised draft for instructor feedback.	1. 15-20 minutes 2. 15-20 minutes 3. Out of/after class	• Groups may need monitoring or encouragement to provide good feedback. The goal is for groups to actually present their posters to one another. • Workshop – Laptop or tablet required from at least one student per group. • Grade posters for completion and provide feedback. • Project Part 5: properly formatted draft poster (LMS) and feedback form from workshop time (paper).
Poster Presentation and Audience Forms	Each group member presents the poster separately. While one member is presenting, the rest act as audience for other students' posters and complete an audience form.	15 min/student Two 45 min sessions, with a break in between	• Project Part 6: Final poster (LMS) and audience form (paper). • It is not possible to observe and evaluate each student presentation without a lot of help from scientists from outside the course. • Audience interest can wane as the time goes, so it is important to keep them engaged with the feedback form.