

# The Comics Project: Synthesizing and Communicating Science with Comics

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## Abstract

Students, especially non-science majors, often see science as abstracted from their daily lives. Moreover, students often struggle to translate scientific concepts into everyday language in order to communicate to their communities what they have learned about those concepts. The Comics Project is designed to humanize biology so that students understand the relationship between science and issues that they face in their lives. Students are challenged to de-jargonize science and communicate their understanding visually by creating a comic, either individually or as a group. The project is flexible to fit in any type of course. Students are introduced to scientific literature and learn to use high-quality sources of scientific information. Then, students develop comics to communicate about their questions regarding socio-scientific issues which may be as related to the course topic as the instructor desires. For example, students might explore questions such as: Does BPA affect male fertility?; What is the genetic component of skin cancer?; or How do microplastics affect our water supply? Students create comics to synthesize what they learn from exploring primary literature. The comics are appropriate for sharing on social media. Comics are a powerful and accessible way to make science come alive for non-scientists. Through this process, students come to see science as meaningful in their own lives beyond the classroom and learn to communicate complex science with simple visuals.

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**Supporting Materials:** Supporting Files S1. Comics Project – Rubric; S2. Comics Project – One Paragraph Guidelines; S3. Comics Project – Peer Review of One Paragraph; S4. Comics Project – Annotated Bibliography Rubric; S5. Comics Project – Feedback and Peer Review; S6. Comics Project – Presentation Guidelines; S7. Comics Project – Student Examples; and S8. Comics Project – CRAAP Test Presentation.

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## Learning Goal(s)

- Students will know how to identify and use high-quality sources of scientific information.
- Students will understand the relationship between science and society (AAAS, 2010).
- Students will value the role of science information to inform their daily lives.
- Students will know how to translate complicated science to simple visuals and everyday language, using comics, in order to communicate scientific findings to a larger audience.

## Learning Objective(s)

- Students will be able to use the CRAAP Test to evaluate the quality of various sources of scientific information.
- Students will be able to discuss the relationship between science and society.
- Students will be able to draw simple comics to communicate scientific information.

## INTRODUCTION

As science educators, one primary goal is to support our students to develop science literacy (1). For science literacy to be truly useful, students must become “competent outsiders” capable of engaging with scientific information to make everyday decisions (2,3). One major goal of the Comics Project is to provide an opportunity for students to learn to engage with scientific information that is relevant to their personal lives. At the same time, students are challenged to communicate what they learn to a broader audience using the simple visuals and everyday language of comics.

The Comics Project addresses a core competency and disciplinary practice of “science education for civic engagement

and responsibility,” so that students develop the ability to understand the relationship between science and society (4). The Comics Project starts from the understanding that biology is conducted in a societal context. Students ask questions that are relevant to their own lives and communities. They explore scientific literature and create a comic synthesizing what they learn. In this way, the Comics Project humanizes biology so that students connect concepts to their own lives. At the same time, students learn to identify and use high-quality sources of scientific information to create their own comics to communicate about science with their communities. The Comics Project includes multiple scaffolded assignments over the course of a three-week unit and culminates in the creation of a social media-shareable comic communicating biology relevant to students’ everyday life.

### *Engaging with Scientific Information*

Since Americans increasingly obtain their science information from the internet and other media (5), students must learn to critically evaluate sources of scientific information (6). However, most science courses do not teach students information literacy skills, such as evaluating the quality of sources of scientific information and weighing evidence to make informed decisions (6-8). Without these skills, students' ability to improve their understanding of scientific issues is limited, as they cannot access necessary information (9).

Therefore, students need opportunities to practice finding scientific information and evaluating sources for themselves, in real-world situations, to develop these crucial skills. The Comics Project provides opportunities for students to develop information literacy skills, which includes evaluation of sources of scientific information. This is actionable science literacy that students will use beyond the classroom (10,11).

For the Comics Project, students are charged with finding and evaluating sources of high-quality scientific information. Given a particular student population, course level, and learning goals, instructors may choose to define high-quality sources of scientific information as newspaper articles and textbook information and/or primary literature.

### *Why Comics?*

Comics are a powerful way to make science accessible for decision-making (12). A picture is literally worth a 1,000 words: they are easier to recognize, process, and recall than words (13). Comics can make the most complex of concepts instantly understandable. Making comics are ideal for having students learn to "de-jargonize" science and translate it into everyday language and clear visuals. Text and pictures together have an even greater advantage than pictures alone: humans can recall informative images better than decorative images, because informative images provide "clarifying examples, extra-lingual information, and context for interpretation," which facilitates learning (13). Additionally, comics can make uncomfortable issues easier to address (14). Comics make science come alive with compelling storytelling, science journalism, and engaging illustrations. Finally, comics make science approachable for people who typically do not engage with, or have access to, scientific literature. Thus, students' work has the potential to reach diverse communities.

Importantly, drawing has been described as a science process skill for both learners and scientists (15) and an important disciplinary practice (16). Students learn more from combining text and visual information than from text alone (15). Drawing is also a powerful tool for communicating scientific information.

### *Intended Audience*

The Comics Project is readily adaptable for both non-science majors and science majors of all levels as well as for a range of class sizes. The Comics Project was developed at Gallaudet University, in a course that is open to all students. The university is classified as an open enrollment, non-selective liberal arts college. The Communicating Science with Comics Project was developed for a four-credit, 200-level class, Learning Science Through Stories, that meets twice a week for two hours total per week in a 15-week semester. Originally, three Comics Project units were embedded in the course to correspond with three

units on distinct socio-scientific topics (infertility, cancer, and AIDS) within a four-credit, 200-level class that meets twice a week for two hours total per week in a 15-week semester (20). The course is not required and serves non-science majors. The course is not a traditional introductory biology course; it is a course designed to meet general education requirements. The course serves 12-21 students and is led by one instructor. The course demographics reflect those of the university (88% deaf, bilingual ASL-English signers). However, the Comics Project is designed to be flexible for the needs of a diverse range of courses, including both non-majors and majors of all levels and a range of class sizes.

### *Required Learning Time*

The Comics Project is divided into six 50-minute class sessions that are completed over the course of a three-week unit. Multiple units could be implemented over the course of the semester. Much of the work is completed in class in order to scaffold students' fledgling research skills and support students with just-in-time formative feedback from both their peers and the course instructor. However, the Comics Project could be adapted as an out-of-class activity following instruction about how to identify and evaluate sources of scientific information. The Comics Project culminates in students sharing their work via social media as well as in class via a presentation to an audience of classmates, the instructor, and invited departmental guests, if the instructor so desires.

### *Prerequisite Student Knowledge*

No specific prerequisite knowledge is needed beyond being familiar with what comics look like. Students use scientific concepts learned throughout the course to complete the project and to develop information literacy skills, such as searching for relevant scientific information and articles, as part of the scaffolded assignments.

### *Prerequisite Teacher Knowledge*

There is no specific prerequisite knowledge for instructors beyond being familiar with what comics look like. It is assumed that instructors are familiar with the course content in which they plan to embed the Comics Project. While students' comics can be produced low-tech using pencil and paper, if instructors wish students to create sleeker art, they might encourage their students to explore the many freely-available drawing apps using a web search.

## **SCIENTIFIC TEACHING THEMES**

### *Active Learning*

Nearly every part of the Comics Project utilizes an active-learning approach (17). Students' learning is self-directed. Students follow their own interests, exploring scientific issues that they find most intriguing—with the instructor determining the latitude for range of issues explored. Students work individually or in small groups to conduct literature searches using library resources, internet searches, and databases such as Pubmed to search for high-quality sources of scientific information. Students are encouraged to start by reading news articles and research reviews and summaries to familiarize themselves with background information before diving into more complicated primary literature. Students synthesize the information they find. Students develop a narrative, which integrates the science in a story. Finally, students create a visually-compelling comic.

Peer feedback is a part of the comic development process (18). The project can culminate in either or both of the following products: social media-shareable comics, which students share with their families and friends; and in-class presentations, in which students present their comics as well as reflections about their working process.

### Assessment

Formative feedback as well as a numerical grade is provided for each scaffolded assignment, both of which contribute to the development of the final comic. At the end of the three-week unit, summative assessment of the final digital comic and presentation is conducted, which also could include evaluation by students' digital communities, if the instructor so desired. Rubrics are provided to students for each scaffolded assignment to guide their process.

### Inclusive Teaching

The Comics Project is an opportunity for students to exercise choice in their learning, following their own interests to explore socio-scientific issues that pique their curiosity. Student projects can represent a broad range of topics depending on instructor guidelines and curricular needs.

The development and presentation of a comic encourages students to use visual communication rather than rely on words alone to clearly communicate science. Visual communication is an important strategy to engage the bilingual Deaf community in science (19). Visual communication is also useful for students who are English language learners and for students with disabilities.

Additionally, scientific information is often inaccessible due to journal pay walls and unfamiliar scientific jargon. Comics told in everyday language with compelling illustrations make science accessible and relevant to a larger audience.

## LESSON PLAN

### Overview

The Project could be implemented in one-to-two 50-minute class sessions as an exercise for students to practice finding high-quality sources of scientific information and synthesizing what they learn in a comic. In this case, students should be encouraged to focus more effort on finding reputable sources and using simple art such as stick figures and word bubbles to communicate their messages. Alternatively, the Comics Project can be implemented as a long-term project, ranging from three weeks to an entire semester. Below, I describe a three-week-long iteration of the Comics Project. Supporting Files included are designed to support a three-week-long iteration of the Comics Project but can be modified to fit individual course needs. The Comics Project could be also be scaled for a larger class, using group projects to maximize formative feedback.

### Classroom Arrangements & Supplies for Creating Comics

If classroom seating is moveable, faculty might arrange student desks in a circle rather than in traditional, stadium-style seating. Circular seating has universal benefits, as it promotes social interaction, which is key for classroom discussions (21,22). This is especially helpful when discussing formative feedback for the Comics Project.

Students are required to bring their laptops for some classes as indicated in the lesson plan. A table of the assignment timeline is included (Table 1). Students may use a variety of materials of their own choosing to create their comics including drawing apps as well as lower-tech options such as pen and paper.

Comics can be created using multiple modalities. Because students can create comics by drawing by hand and scanning their work, instructors should caution students to draw and letter text legibly, large and dark enough so that scanned work is clearly readable. Instructors should also caution students to draw on one side of the paper only, as double-sided work may result in lower-quality scanned work. Students can also create comics using a variety of freely-available apps for iPads and tablets. Well-regarded free drawing apps include: Autodesk Sketchbook; Adobe Illustrator Draw; Paper; Animation Desk; Adobe Photoshop Sketch; and Tayasui Sketches. However, instructors may wish to research the latest recommended free drawing apps for their class. Alternatively, students can create comics on PowerPoint slides with free vector icons, which are essentially prefabricated, nicely-drawn stick figures, via websites such as flaticon.com, freepik.com, and thenounproject.com. For students who are less confident in their drawing abilities, and wish to use stick figures, instructors may share resources such as Lynda Barry's video discussing very simple drawing techniques: <https://www.youtube.com/watch?v=ILhXhTwgty8> and the webcomic XKCD for stick figure inspiration: <https://xkcd.com/>. Instructors may also want to read Lynda Barry's books, *Making Comics* and *Syllabus*, to become more familiar with making comics. Finally, instructors should make students aware that image quality will be higher if they draw larger images and then reduce them in size for social media sharing.

### Pre-Semester Preparation

Questions below concerning logistics and goals may help instructors with decision-making about key project details.

- What topics will the course focus on? How are course topics related to students' comics topics? How much freedom will students have to choose their topics for their comics? In our class, students were given freedom to develop Comics Projects for a variety of purposes: to communicate what they learned from researching a query they had related to our course unit topics—which were infertility, cancer, and HIV/AIDS (e.g., how tumors cause pain; how cigarettes killed my mom) or to communicate accurate understanding of a common misconception to a broader audience (e.g., infertility is not only a woman's issue; condoms are not 100% effective). Instructors may hone the project purpose for their course needs.
- Will the Comics Project be an individual or group project? If the Comics Project is a group project, how will groups be formed? Groups could be formed by topic interest or randomly by seating assignment made by the instructor. How many groups will there be, and how many students per group? If groups are used, will students be assigned particular roles and responsibilities for the project?
- Will the comic be printed or electronic? And, how will it be presented? In our class, each comic was presented as part of a PowerPoint presentation, so comics were ultimately scanned if they were created by hand. Students also shared their work on social media.

- How long will the Comics Project continue? One day? Three weeks (as described here)? Semester-long? Will multiple Comics Project units be used?
- Will the Comics Project be primarily conducted in class or will students complete it outside of class?
- What percentage of the grade will the Comics Project be worth? How many points will be assigned to each scaffolded assignment (one paragraph, annotated bibliography, drafts and peer review, final project)? In our class, the Comics Project final comic is worth the equivalent of one test grade. Smaller scaffolded assignments count toward students' homework grades. Alternatively, the entire Project could be worth one exam grade. Rubrics (see Supporting Files) offer recommended point values.

### *Schedule for the Comics Project Unit*

#### *Part 1: Exploring Background Information and Identifying a Project Topic—Week 1*

Students explore the topic background related to the question that they are researching to make their comic, learning essential scientific concepts necessary before diving into more complex related issues of their choosing. The instructor determines how related to the course the Comics Projects must be. In our class, students had developed some conceptual knowledge about the broader topic of the Comics Project before delving into designing a comic to address a specific idea or query of their own.

Prior to class, the materials in the Supporting Files are adapted as needed to fit the project topic. Then, the materials are posted to the course learning management system. The instructor directs students to these materials and explains the learning goals.

#### Class Session 1 and Homework

The Comics Project is introduced to students (Supporting File S1. Comics Project – Rubric). The goal of Class 1 is that students will learn about different types of sources of scientific information, for example, primary scientific literature versus news media. Students are introduced to the CRAAP Test, a tool developed by librarians for the purpose of evaluating the quality of a source (23). The CRAAP Test is an acronym for currency, relevancy, authority, accuracy, and purpose. Each word is an essential ingredient to this screening test, to see if sources “pass” the CRAAP Test. Currency refers to how recent the information is. Relevancy refers to whether the source includes information that is relevant to one's query or topic of interest. Authority refers to the author's (and source or publisher's) credentials on the topic. Accuracy refers to the reliability and correctness of the content. Finally, purpose refers to the reason the source exists, for example, to educate, to persuade, to sell an item, or to entertain. Taken together, the CRAAP Test can be used as a filter to determine if sources of information are high-quality sources or not (i.e., does a source contain the most up-to-date information, is the information relevant to the question, is the source authored by someone with expertise on the subject, can this information be verified to be accurate, and was this information published to inform people). After the instructor introduces the CRAAP Test, students are tasked with identifying a project topic and beginning to search for high-quality sources. Instructors can determine, based on their student population and course level, how to define “high-quality sources.” For an introductory class, this might mean news articles and textbook

information, while for advanced classes, this might mean solely relying on primary literature. In our class, a 200-level class for non-science majors, high-quality sources spanned from information on websites such as the CDC.gov, MedlinePlus, the American Cancer Society, Harvard Health Publishing, and NIH US Department of Health and Human Services to primary literature and review articles. Sources used depended upon students' comic topics.

Students use the CRAAP Test to evaluate potential sources, while the instructor provides immediate feedback about the type and quality of sources, reinforcing the CRAAP Test. This activity requires about 10 minutes of class time to explain the CRAAP Test. Instructors could choose to include additional activities to assess students' understanding of the CRAAP Test, such as clicker questions that ask students to justify which source they would choose. Likewise, this activity could be translated to a brief discussion or a think-pair-share activity in a small class.

Out of class, students write one paragraph about their topic of choice for their Comics Project. Instructions for this assignment are provided (Supporting File S2. Comics Project – One Paragraph Guidelines).

#### Class Session 2 and Homework

During Class 2, students participate in peer review of their one paragraph about their Comics Project topic. The instructor guides students to focus on giving feedback about the topic choice, in particular, providing feedback to address the following questions: is the topic compelling, why is this topic important, identify major misconceptions about this topic that should be addressed, why should we care about this topic (Supporting File S3. Comics Project – Peer Review of One Paragraph). Students use this feedback to inform their Comics Project. In class, this activity requires 15 minutes. The instructor might also choose to lead a discussion in which the entire class “norms” their feedback for one paragraph; this might take an additional 15 minutes.

Out of class, students develop an annotated bibliography, identifying suitable references for their Comics Project (Supporting File S4. Comics Project – Annotated Bibliography Rubric).

#### *Part 2: In-Class Work on Comics Project and Peer Review—Week 2*

Week 2 focuses on students creating their Comics Projects and participating in peer review to improve the quality of their work.

#### Class Session 3 and Homework

Students spend the entirety of Class 3 working on their Comics Projects. This in-class work time provides innumerable opportunities for real-time feedback from the instructor, sets explicit expectations, encourages high-quality student work on the project, and offers students glimpses at their classmates' processes. Our students often juggle many responsibilities outside of class including, but not limited to, family responsibilities, one or more jobs, and other course work. Providing in-class time to work on the Comics Project could also be used as an opportunity for the instructor to model their own working process, perhaps working alongside students on a Comics Project of their own. Alternatively, instructors could choose to assign this work out of class. However, instructors should be aware that students would not receive real-time feedback in the same way.

### Class Session 4 and Homework

Class 4 revolves around either whole-class or small-group peer critique and feedback of every Comics Project. In either case, each student first briefly summarizes their Comics Project and asks for specific feedback, if applicable. Then, students read and review their peers' Comics Project. Feedback is given via a whole-class or small-group discussion (Supporting File S5. Comics Project – Feedback and Peer Review). Feedback is also recorded in writing for each student; before the feedback session begins, the instructor asks for volunteers to record the feedback. If feedback is provided in small groups, one recommendation is to model the feedback process for one student's Comics Project. Alternatively, in large classes, the instructor could set up an online discussion board assignment where 3-5 students could provide feedback for each comic.

### *Part 3: In-Class Work on Comics Project and Presentations—Week 3*

During week 3, students revise their Comics Project in response to the feedback they receive from the peer review process. At the end of the week, students present their Comics Projects in class and/or share their work on social media.

### Class Session 5 and Homework

Class 5 is devoted to time for students to work on revising their Comics Projects, responding to the feedback that they received from the peer review. This is the final opportunity for real-time feedback from the instructor and from their classmates. This work can be completed either in or out of class depending on other course activities.

Outside of class, students work to finish their Comics Project as well as a PowerPoint presentation reflecting on the experience of researching and creating the comic. The instructor clarifies final questions about project expectations (Supporting File S6. Comics Project – Presentation Guidelines; Supporting File S7. Comics Project – Student Examples).

### Class Session 6 and Homework

The last class of the unit centers on students presenting their finalized Comic Projects. One-by-one (or group-by-group), students present their Comic Projects; explain why they chose this topic; and share their reflections about carrying out the project, the process of drawing the comic, what they learned from researching this topic, and what they learned as a result of creating a comic. Instructors should recommend that students use PowerPoint slides to share each comic panel or page, emphasizing the importance of using a font size that is large enough to be legible. Students may also read their comic aloud and describe their images to support inclusive accessibility for classmates. Faculty may choose to invite guests to the final presentations, to share students' findings more widely to a general audience. Alternatively, students might share their work on an online learning management system discussion board, sharing a brief video presentation and their comic.

To make this activity more authentic and meaningful to an audience beyond the classroom, instructors may decide to ask students to share their work on social media (e.g., Instagram is particularly well-suited for visual work such as comics). Guidelines and expectations for having students share their work on social media are provided in Supporting File S1 and S6. Instructors may wish to consult their institutions for policies

about social media sharing and FERPA. Some students may be concerned about using their real names online. Students can also share their work anonymously by setting up a social media account that is linked to a pseudonym rather than their real name.

## TEACHING DISCUSSION

The goals of the Comics Project include that: students connect science with their everyday lives, students learn to find and interpret data from high-quality sources of scientific information, and students communicate science to their personal networks by creating a social media-shareable comic about socio-scientific issues. Through multiple scaffolded assignments over the course of the three-week unit, students are guided with formative feedback to develop interesting, evidence-based Comics Projects.

### *Effectiveness of the Comics Project*

Student reflections and evaluations informed the lesson plan for the Comics Project. Common student reflections included that communicating science via a story was a challenging and interesting task. One student noted that: "One of the struggles I had was figuring out the balance between information and imagery. This was an interesting process that took a lot of thought and critique." Students also noted that they felt that they learned to draw better and enjoyed that process. Drawing has been described as an important STEM disciplinary practice (16). The Comics Project provides opportunities for students to practice this key skill. Additionally, drawing itself can lead to higher gains in science learning (15).

Other student reflections included the realization that researching a question by querying scientific articles takes time, but that this part of the project was interesting. Another student commented that after completing the Comics Project, "I feel like I know the topic very well."

Informal evaluations about the Comics Project included positive feedback from students. One student noted: "I can identify good sources of scientific information. I am curious about biology and I enjoyed learning more about these topics." Another student noted that her interest in biology grew and the Comics Project improved her understanding.

When asked what the most valuable thing was that they would take away from the course, several students commented that "finding high-quality sources to use" was most valuable. Some students noted that analyzing and interpreting ideas from multiple sources in their projects was a valuable take-away from the course.

Nine out of ten students (90%) were somewhat to very confident in their ability to identify and use high-quality sources of scientific information (Table 2). Overall, students were also confident in their ability to analyze and interpret ideas from multiple sources, with 80% noting that they were somewhat to very confident. Ten out of ten students (100%) completing the evaluation form agreed that the Comics Project helped achieve our learning goals (Table 2). Finally, nine of the ten students (90%) described being more curious about biology in their lives (Table 2).

### Defining the Scope of the Comics Project

The scope of students' Comics Projects is flexible depending on the instructor's preferences and the structure of the course. The scope of the project could be based on the scope of the course content, or topics can be determined at the instructor's discretion. Alternatively, the scope of students' Comics Projects could be determined by students themselves. In our class, students developed Comics Projects related to the socio-scientific issues we explored via our reading of graphic non-fiction narratives about infertility, cancer, and AIDS. Work can take place in or outside of class depending on the specific course goals and other course activities.

### Individual versus Group Work

The Comics Project can be carried out either individually or in a group. With group work comes the inherent dynamics of working with others, bringing both positive and negative issues. Since our class was small, students worked individually on projects of their own choice.

### Conclusion

The Comics Project is an opportunity for students to make science relevant to their everyday life by exploring a socio-scientific issue in depth. The Comics Project helps students to learn to identify and use data from high-quality sources of scientific information. Students report enjoying developing a Comics Project about a socio-scientific issue of their interest. Extensive formative feedback helped students to revise their projects. The Comics Project is a creative medium that students are excited to share with their communities via social media. The Comics Project prepares students to engage with science beyond the classroom, as they learn to navigate scientific literature in order to explore and address their own questions.

### IRB

Anonymous student reflection quotes are included. My research was submitted to Gallaudet University's IRB and determined to not need an official review. Gallaudet IRB determined that my project did not fall under the scope of what IRB categorizes as active research with human subjects.

### SUPPORTING MATERIALS

- S1. Comics Project – Rubric
- S2. Comics Project – One Paragraph Guidelines
- S3. Comics Project – Peer Review of One Paragraph
- S4. Comics Project – Annotated Bibliography Rubric
- S5. Comics Project – Feedback and Peer Review
- S6. Comics Project – Presentation Guidelines
- S7. Comics Project – Student Examples
- S8. Comics Project – CRAAP Test Presentation

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**Table 1. The Comics Project Teaching Timeline**

Activity	Description	Estimated Time	Notes
<b>Part 1: Exploring Background Information and Identifying a Project Topic—Week 1</b>			
<b>Class Session 1</b>			
Students find high-quality sources of scientific information.	<ol style="list-style-type: none"> <li>1. Students are introduced to the CRAAP Test, a tool to evaluate the quality of sources of information.</li> <li>2. Students identify high-quality sources of scientific information.</li> <li>3. The instructor provides in-the-moment feedback about the quality and type of source.</li> </ol>	One 50-minute class period	<ul style="list-style-type: none"> <li>• The Comics Project Rubric is included in Supporting File S1.</li> <li>• An example PPT with an explanation of the CRAAP Test is provided in Supporting File S8.</li> <li>• A laptop is required for searching for references.</li> <li>• It is recommended that at least some class time is provided for students to search for references, since students are often unfamiliar with different types of sources of scientific information (e.g., primary literature versus news media accounts of science).</li> </ul>
<b>Class Session 2</b>			
Peer review of students' one paragraph about their topic.	Out of class, students write one paragraph about their topic. In class, students peer review each other's paragraph. Peer review focuses on justifying a "need to know" and identifying crucial elements and information to include in their comics.	One 50-minute class	<ul style="list-style-type: none"> <li>• Guidelines for the one paragraph are included in Supporting File S2.</li> <li>• An example PPT with guidelines for peer review and feedback is provided in Supporting File S3.</li> </ul>
<b>Part 2: In-class Work on Comics Project and Peer Review—Week 2</b>			
<b>Class Session 3</b>			
In-class work on comics.	Out of class, students finish identifying references and develop an annotated bibliography. Students spend one class session working on their comics and receiving informal, in-the-moment feedback.	One 50-minute class	<ul style="list-style-type: none"> <li>• A rubric for the annotated bibliography is included in Supporting File S4.</li> <li>• A day devoted to students creating comics helps set expectations for quality of work, makes rubric expectations explicit, provides opportunities for real-time feedback from both the instructor and the students' peers, and offers students glimpses at their peers' work.</li> </ul>
<b>Class Session 4</b>			
Peer review of students' comics drafts.	One class is spent conducting whole-class (or group) peer review of students' comics drafts.	One 50-minute class	<ul style="list-style-type: none"> <li>• Students are encouraged to share nearly-finalized comics in order to maximize this feedback opportunity.</li> <li>• Guidelines for feedback and peer review are provided in Supporting File S5.</li> </ul>
<b>Part 3: In-class Work on Comics Project and Presentations—Week 3</b>			
<b>Class Session 5</b>			
In-class work on comics.	Students spend one class session working on their comics and receiving informal in-the-moment feedback.	One 50-minute class	<ul style="list-style-type: none"> <li>• A day devoted to students creating comics provides opportunities for real-time feedback from both the instructor and students' peers as well as offers students the opportunity to ask final questions about assignment expectations and issues related to biology content and comics creation.</li> <li>• A PPT with comics presentation guidelines can be found in Supporting File S6.</li> </ul>
<b>Class Session 6</b>			
Student presentations.	Students present their comics to the class. Students share the biology they learned as well as reflect on comic creation and what they learned through the process.	One 50-minute class	<ul style="list-style-type: none"> <li>• Students may also share their comic project via social media.</li> </ul>

**Table 2. Students' confidence in their abilities to complete Comic Project goals.**

Comic Project Goal	Not confident	Slightly confident	Somewhat confident	Very confident
Identify and use high-quality sources of scientific information.	0%	10%	40%	50%
Summarize scientific information in your own words.	0%	30%	20%	50%
Analyze, interpret, and synthesize ideas from multiple sources.	0%	20%	40%	40%
Critically question and challenge your assumptions..	0%	40%	20%	40%
Communicate your findings in a meaningful way to a general audience.	0%	20%	40%	40%