

## Shining a Light on 'Plant Apathy': Using Kenneth Oppel's Young Adult Novel *Bloom* as a Motivating Tool for Teaching Plant Science to First-Year Undergraduate Students

The curriculum was designed for a first-year college freshmen, but could be adapted for high school or AP Middle School biology.

**Background:** We used our grant money from this project towards educational materials and faculty stipends so that we could develop the curriculum for a First-Year Experience course. The context/content (we call this the "Soil") in which we taught students to develop reading, study, and metacognitive skills was plant biology. We used the young adult novel, "Bloom" by Kenneth Oppel, to guide students' reading, inquiry, and content knowledge. We used some of the funds from the grant to have the author meet with our class via Zoom. This class had the theme of STEAM (Science, Technology, English, Art, and Math). Projects that students completed in class moved up in Bloom's Taxonomy (the fact that the book was also Bloom and the grant was Bloome was apropos). Students began with creating flashcards and memorizing vocabulary. Then, they applied concepts to make claims and ended by creating an inquiry-based podcast where students assumed the role of expert plant scientists and used primary research and popular articles to discuss whether plants were "sentient or intelligent beings". One of the most fun projects was to have students use their art skills to paint large-scale alien plants (from the book's descriptions) and "terraform" one of the study rooms in our science center to look like the final scene from the book. The feedback we received from the students in their "letter to future freshmen" taking this course was overwhelmingly positive with many students saying that they learned more in the course than they expected and had fun while doing it. There are still student artifacts to analyze and other sources of data (student surveys, freshmen letters, course grades) which we plan on triangulating this academic year.

One final reflection that I want to add focuses on the nature of this course. Due to our teaching schedules, we used our BLOOME grant to create course materials and resources for a Freshmen Year Seminar/Experience Course that we were both assigned to teach. If we teach this course again, it will not be in this format. The materials we created would be better suited for a non-major's General Botany or Plant Biology course where they focus is on content acquisition and mastery of scientific material. FYE at Fitchburg State is designed to help students learn skills (reading, note taking, metacognition, studying), but not content. However, in order to learn these skills, *there must a contextual theme for the course* (aka content); we used plant biology. In hindsight, some of the materials and concepts that we were teaching were beyond the scope of a first-year seminar course which may have overwhelmed students who were not science majors.

**File Use Guidelines- See Next Page**

Individual files are linked within the table under the "Linked files" column. These files may be found on the ASPB Plantae page.

Activity or Product	Quick Description/ Teacher Prompt	Time to complete	Supplies Needed	Estimated Cost	Linked files
Course Syllabus	The syllabus explains how this First-year experience course was taught, what assignments were required, and when each of the activities was done. The curriculum is based around the YA novel "Bloom" by Kenneth Oppel which is a fictional novel about alien plants. The book is chock-full of accurate information about plant biology. If this class were to be taught again, it should not be in an FYE format, but rather as a separate General Botany or non-majors science course.	7-8 weeks			<a href="#">Syllabus, supplies list</a>
Course Schedule	Daily class schedule at-a-glance. This shows the order in which each of the activities should be done.				<a href="#">Schedule</a>
Flash Card Project for learning botanical vocabulary- "Thinking like a Plant Scientist"	Students learn vocabulary such as photosynthesis, allomones, rhizomes, tendrils, enzymes, invasive, differentiated, amino acids, DNA, and others. Before reading the book, students will be given the page number of each term and will have to use context clues from the text to define the words on flash cards. This helps students develop active reading skills and learn word meanings from context while also learning vocabulary. This was done using Google slides. Students can share out their words.	60-75 min	Internet access		<a href="#">Google Slide Deck with Vocabulary</a>
Bloom Reading Logs	These are logs students use when reading the book to guide their thinking and take notes.	7-8 weeks	Book: Bloom by Kenneth Oppel	\$9 each	<a href="#">Reading Log Templates</a>

<p>Invasive Species Canva Poster and activities</p>	<p>This is part of a unit on invasive species. Students read a short article about invasive plants in the area. The teacher gives a short lecture on invasive species and then takes students on a nature walk around the school to ID plants. Students are then assigned 1 invasive plant to investigate and create a wanted poster. This parallels the "extraterrestrial/alien" species of plants from the book. Students in class used the free app Canva, but students can also use Google Slides or Powerpoint. This meets ASPB's Principal for Teaching Plant Biology's Standard on Ecosystems: Biodiversity.</p>	<p>3 X 75 min</p>	<p>None</p>		<p><a href="#">Invasive species lecture</a>, <a href="#">plant walk activity</a>, <a href="#">article</a>, <a href="#">Canva Poster examples</a></p>
<p>Plant Secondary Metabolites lecture and activity (free, 75 min)</p>	<p>This is a short lecture and activity about plant secondary metabolites. The alien plants in a book use a perfume to put victims to sleep. This parallels that storyline. After the activity, students have to move to corners of the room to answer questions about different plant secondary products. This meets ASPB's Principal for Teaching Plant Biology's Standard on Molecules to Organisms: Specialized Metabolites</p>	<p>60 min</p>	<p>None</p>		<p><a href="#">Lecture and activity prompt</a></p>
<p>Photosynthesis lab</p>	<p>One of the startling traits of the alien plants depicted in Bloom is their unusual color; they are black. According to one of the main characters in the book who is a plant biologist, "this means they can photosynthesize at any wavelength of light" (p. 48). To deepen students' understanding of the process of photosynthesis and to enable them to hypothesize which color light in the visible spectrum causes the fastest rate of photosynthesis in spinach, students will do a simple experiment using leaf disks with the air removed. Students placed plant disks in a bicarbonate solution, expose them to different colors of light and count how quickly each of the disks floats to the surface. From these data, students determined which is</p>	<p>2.5 hours</p>	<p>Spinach leaves, hole punches, desk lights, colored light bulbs, sodium bicarbonate solution, tin foil, syringes, test tubes</p>	<p>\$200 for supplies</p>	<p><a href="#">Photosynthesis lab handout</a>, <a href="#">Photosynthesis notes</a></p>

	<p>the best wavelength of light for photosynthesis. Questions that deepen their thinking about why the black, alien plants in Bloom have an advantage over Earth plants in their ability to utilize all the colors of the visible electromagnetic spectrum can be asked. This meets ASPB’s Principal for Teaching Plant Biology’s Standard on Molecules to Organisms: Photosynthesis. Additionally, this addresses Project Vision &amp; Change’s recommendations for pathways and transformations of energy and matter.</p>				
<p>Seed Dispersal lab (\$70, 150 min)</p>	<p>The plants that Opper depicts in <i>Bloom</i> also stand out for their ability to disperse their seeds in a hyper-aggressive way; ejecting seeds by spitting them out like acidic bullets from a large flower head. To learn about seed dispersal, students gather maple samaras (helicopters) locally and measure their weight and total “wing” (pericarp) area. Next, from the stairwell or balcony, students drop the samaras and measured dispersal as the distance from a plumb bob at different heights. Students make hypotheses, collect data in a lab notebook, graph weight against height and area, and analyze the role that seed characteristics have in successful dispersal. Students answer questions using the lab handout and discuss final results, graphs, and data as a class. For upper-level or AP classes, students can be asked to write a lab report. This meets ASPB’s Principal for Teaching Plant Biology’s Standard on Heredity: Population &amp; Quantitative Genetics. Additionally, this addresses Project Vision &amp; Change’s recommendations for scientific inquiry and the ability to apply the process of science.</p>	<p>2.5 hours plus additional discussion time as needed</p>	<p>Plumb bobs, yarn or rope, maple samaras, metric tape measures, gram scale, app for measuring area (We used the free app LeafScan from the Apple Store on an iPad).</p>	<p>\$75, more if gram scale is not available at the school.</p>	<p><a href="#">Seed Dispersal Handout</a></p>

Podcast Project (75 X 4 min)	The denouement of the novel reveals the extent to which the alien plants are both intelligent and sentient because they understand their environment, have strategies to take on their opponents, and are able to communicate. This after-reading activity asks students to explore the ways Earth plants could be considered “intelligent” in how they adapt to their environments. Students use scientific thinking for this project as they create and share a podcast investigating these central issues. Serving as expert witnesses and drawing from their growing mastery of plant biology topics, students used evidence from the book, scientific digests, primary references, and other library resources to contend that plants are intelligent beings. If this is done with younger students, the teacher can provide simpler articles for them to read. This meets ASPB’s Principal for Teaching Plant Biology’s Standard on Evolution: Environmental Responses.	5 X 75 min	Access to library resources and a phone or device to record the podcast.		<a href="#">Podcast Project Handout</a>
Time-lapse plant growth project	In <i>Bloom</i> , the plants grow so quickly, their vines seem snake-like. There are many earth plants that grow quickly, but in this activity, students used time-lapse photography to visualize plant growth. This was followed by a “film festival” of plant growth via time-lapse photography and a discussion on perceptions of time & plant lifespans. If a time-lapse camera is not available students can also use their own phones and take 1-2 photos each day and create a short video. Cost and time will vary depending on resource availability. We used a growth chamber, soil, Arabidopsis seeds, seed tray, and a Brinno time lapse camera.	Time varies	Growth chamber, soil, Arabidopsis seeds, seed tray, and a Brinno time lapse camera.	~\$175	<a href="#">Time Lapse Activity Prompt, movie example</a>

Author Seminar Reflection	After students were done reading and discussing the book, we contacted Kenneth Oppel, the author and had him talk to our class for 30 minutes about the book and how he came up with the idea. Students were able to ask questions and learn about the writing process. If this is not a viable option, there are book reviews of Bloom online and other resources to lead a book discussion. We have included a link to "Young Adulting: A book review of Bloom" as an example.	30-60 min	None	\$400	<a href="#">Author question prompts, link to alternative activity</a>
Terraformed Classroom	After reading Bloom, students recreate the alien plant world that they visualized in the book and create life-sized artwork versions of the different alien plants (pit vines, water lilies, and black grass). This artwork can be hung up in the classroom. To make the scene more dramatic, dry ice can be used to mimic fog and aromatherapy oils can mimic perfumes and gases from the alien plants	2 X 75 min	Art supplies, paint, butcher paper, pant brushes, colored pencils, sticky putty	\$200	<a href="#">Picture with artwork and decorations in the background.</a>
Letter to First-year students (60 min)	This activity asks students to reflect upon what they learned and write a letter to future students taking this course. Included in the letter should be what the student learned, what they liked about the course, what was challenging, and advice for new students.	60 min	None		<a href="#">Letter to first years prompt</a>
Pre-and Post-Student Surveys (10 min each)	This activity asks students to take a survey about their perceptions and "awareness" of plants before and after the class. This can be used as an assessment to determine if this course helped students become more aware and interested in plants in their environment.	2 X 15 min	None		<a href="#">Pre and Post Survey</a>