ASTRO BEAT

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Figure 1: Example badges designed for students to earn for different levels of mastery in each unit.

Gamified ASTRO 101

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For the Fall 2020 semester during the pandemic, I decided to gamify my intro astronomy classes. Inspired by Professor Jim Marteney at Los Angeles Valley College, who gamified his English class, my students are in an imaginary intern training program at a science center. The goal for them there is to move through the various halls and galleries of the center to learn about different areas of astronomy, in order to be "explainers" and be able to explain astronomy to the visiting public.

My aims in creating the class were to create a class that is flexible for students, especially during a pandemic,

inexpensive (using the OpenStax Astronomy textbook; see https://openstax.org/details/books/astronomy), equitable (using mastery-based grading), and usable in both synchronous and asynchronous online modes or as materials for a face-to-face or hybrid class.

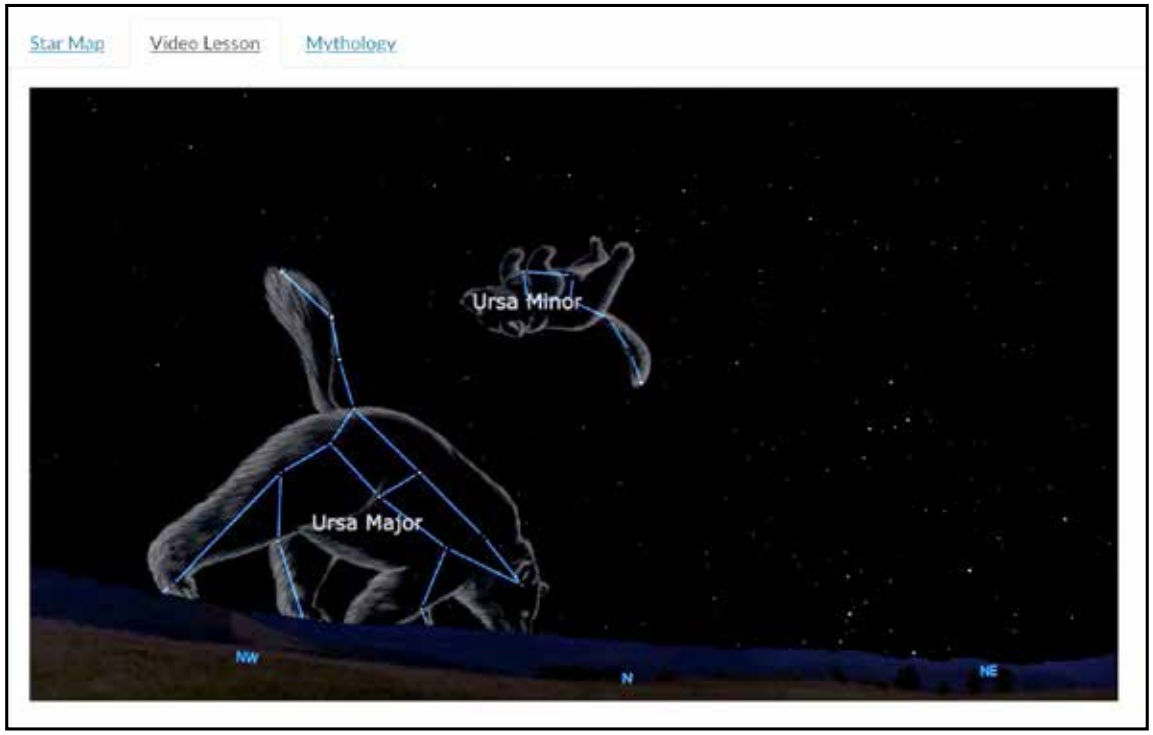

Figure 2: Still image from Planetarium unit "mini planetarium show" made using Starry Night.

The structure of the class contains sequential units of main content that students must complete in order as well as units that have elements that continue throughout the semester. The Planetarium unit has weekly lessons that cover 1-2 constellations and associated bright stars (and the occasional deep sky object) timed to allow students to practice finding the objects in the current night sky. These lessons are videos that are essentially mini planetarium shows that I created using Starry Night (see Fig. 2), as well as interactive activities for practice including crossword puzzles, drag-and-drop labeling, clicking on objects on a star chart, culminating with identifying objects in photos of the real night sky (see Fig. 3).

The Exhibits Department unit has projects that involve teaching someone else (or pretending to). For example, there is a project in which students are paired with an imaginary student group coming to visit the science center, and they're tasked with creating a 2-minute video presentation about an astronomer who is either a woman and/or a person of color (see Fig. 4), so that more of the (imaginary) children (and the students themselves) have an opportunity to see themselves reflected in someone in the field. Another project has students use an existing lesson for kids on either seasons, eclipses, or moon phases (for example, pieces of the kinesthetic astronomy lesson plans from the Space Science Institute) to teach family/friends in their own life. Students really enjoy this process, and they learn these topics better in the process.

Students engage with and learn from each other in

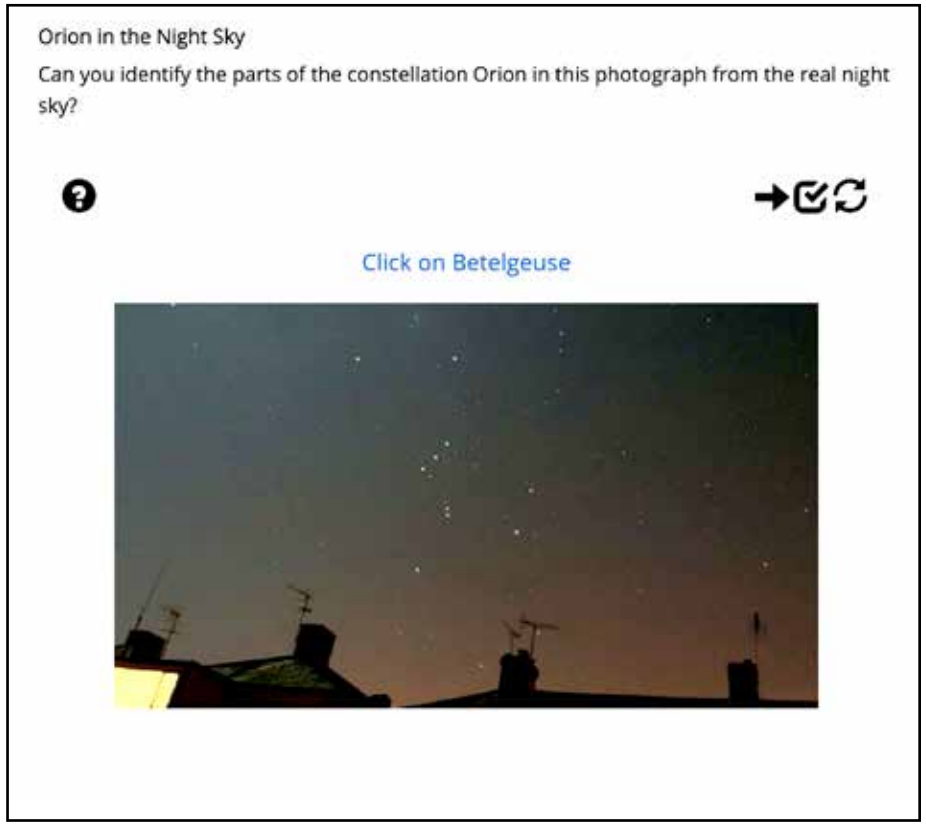

Figure 3: Planetarium unit interactive activity.

the "Intern Lounge" unit. In asynchronous classes, this involves online discussions in ~15-person "Intern Cohort" groups. In synchronous online or face-to-face classes, this involves live class participation on Zoom or in person. All modes of classes have a live (in-person or Zoom) "escape room" instead of a final exam, and in this they work in small groups to solve puzzles using concepts they've learned throughout the semester.

Instead of a traditional grading system, students are awarded badges for different levels of mastery in each unit, including the Novice, Advanced Beginner, Explorer, and Explainer badges. I designed colorful badges for each unit (see Fig. 1), and an app I use in my Learning Management System (LMS) allows students to see an anonymized leaderboard (see Fig. 5), if they wish. Some students like this element of competitiveness (and if they don't, they don't need to look at it). The course grade is based on the number of each type of badge earned.

The grading structure is both challenging and forgiving. Students are required to earn a passing score in almost every unit to pass the course, but this is balanced by a system with equitable/mastery-based grading. Students automatically get two attempts on unit assessments, and they can earn additional attempts by coming to speak with me in office hours. Discussion and project grades are based on rubrics using categories of "Well done," "Good," "Getting There," "Not Quite," and "No Rating Possible" in which missing assignments are given a 50 instead

Figure 4: Still image from a student's Exhibit Department astronomer video presentation.

of 0, based on the argument in the book *Grading for Equity* by Joe Feldman that the 0-100 point scale is not equitable. Feldman argues that should a student miss an assignment and get a 0 and then aces the next assignment, the average would still be failing, and a student finds themselves in a hole that is very difficult to climb out of. The average of a missing assignment and a perfect assignment should actually be an average score of 75, so giving a missing assignment a score of 50 accomplishes this.

RANK	STUDENT	BADGES EARNED	UNIT C - EXHIBITS DEPARTMENT ...	UNIT 2 - HISTORIAN'...	UNIT 2 - HISTORIAN'...	UNIT 3 - OBSERVATORY ...	UNIT 3 - OBSERVATORY ...
#1	Alias: Transparent Lemur	68 of 75					
#1	Alias: Uproarious Raven	68 of 75					
#2	Alias: Substantial Chameleon	67 of 75					
#2	Alias: Lenient Cobra	67 of 75					
#2	Alias: Unseen Salamander	67 of 75					
#2	Alias: Jolly Owl	67 of 75					
#2	Alias: Spotless Salmon	67 of 75					
#3	Alias: Cordial Rabbit	66 of 75					
#3	Alias: Pleasant Cheetah	66 of 75					
#3	Alias: Unexpected Snowy Owl	66 of 75					

Figure 5: An example of an anonymized leaderboard for students.

The lessons are based on the open source OpenStax Astronomy textbook (co-written by former ASP Executive Director Andrew Fraknoi). I use a third-party platform called SoftChalk to create the lessons, which are then embedded directly into the LMS. This is a huge advantage to me as an adjunct professor, as any change to a lesson in SoftChalk is automatically applied to all of my courses across multiple colleges. It also allows me to share the lessons with other faculty. In fact, the course is currently in use at the University of Maryland in addition to my courses at Los Medanos College, Solano Community College, Chabot College, and Las Positas College. I am very willing to share this course in exchange for help with brainstorming lesson design or test bank development.

For many ASTRO 101 students, astronomy is a completely new field. This often translates into difficulty discerning what is most important for them to learn as they read. The lessons therefore include a number of features to assist them. There are embedded videos to engage them in visual learning as well as a variety of activities (crossword puzzles, drag-and-drop and click-on-target activities, for example) to help students check their understanding. I have recorded audio narration of all the

Figure 6: The author at the console during her time at the California Academy of Sciences' Morrison Planetarium in San Francisco.

Figure 7: The author visiting the Keck Observatory in Hawaii.

lesson text to assist those who learn best aurally. I encourage students to follow along in the text as they listen to me, so that they both see and hear unfamiliar words. Students appreciate that the audio makes it feel more like sitting in a classroom lecture. The cognitive load of reading/listening to new information and trying to assess what is most important to note down is quite high. The audio narration helps with this, as students can pause/rewind, and I also created guided notes. Students can print these out to fill in, write on them on tablets, or simply use them as a guide.

I hope that this redesign of my course has improved my ability to engage students in astronomy and hopefully turn some of them into lifelong astronomy enthusiasts. The feedback so far has pointed in that direction, including "By far this has been one of the more exciting college courses I've taken. I am very impressed with the amount of information that I was able to retain because of the way this class was structured," and "I'll be completely honest that in the beginning I only took this class to take something alongside my other courses. However, to my surprise, this ended up being the most fun and exciting class I have ever taken!"

About the Author

Katie Berryhill is an adjunct astronomy professor at Los Medanos College, Solano Community College, and Chabot-Las Positas Community College District, and a 2021 recipient of Solano Community College's Distinguished Faculty Award. In addition, she is part of Arizona State University's Universal Learner Course team, facilitating large-enrollment offerings of ASU's award-winning course, Habitable Worlds, and teaches the course at North Carolina's Southwestern Community

College. She holds a bachelor's in astronomy from the University of Pennsylvania, a master's in space studies from the University of North Dakota, and an Ed.D. in science education from the University of Wyoming. She is also a published narrator of astronomy and education audiobooks. Her research and course development interests are focused on teaching and engagement methods that can help diverse groups of students learn to love astronomy.

Editor's Note

Professor Berryhill is among many astronomy educators and communicators participating in the ASP's 133rd Annual Meeting coming up November 18-20, 2021, and she will be a featured panelist in a plenary session moderated by Andrew Fraknoi and titled "Panel Addressing the Challenges of Teaching Astro 101 in Community Colleges Today." Registration is open now for this ASP2021 Virtual Conference, themed *Sharing Best Practices: Astronomy Teaching and Public Engagement*. More information is available at https://astrosociety.org/get-involved/events/asp2021-a-virtual-conference/.

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