

UCO 1200: Breakthroughs and Controversies in Science and Mathematics

Dr. Sarah J. Greenwald



Contents

1.1	UCO 1200 Catalog Description	1
1.2	Breakthroughs and Controversies in Science and Mathematics Course Description	1
1.3	Required Resources and Materials	2
1.4	Academic Affairs Policies	2
1.5	Learning Activities and Grades	2
1.6	Active Retrieval (AR)	3
1.7	Learning Goals (LG)	4
1.8	Sample Jedi Paths	6
1.9	Where to Get Help and Additional Policies	7
1.10	Advice from Previous Students	9
1.11	Instructor Bio	9
1.12	Acknowledgements	9

1.1 UCO 1200 Catalog Description

The First Year Seminar (UCO 1200) provides students with an introduction to the four goals of a liberal education at Appalachian State University. Specifically, students will practice (1) thinking critically and creatively and (2) communicating effectively. In addition, students will be introduced to the learning goals of (3) making local-to-global connections and (4) understanding responsibilities of community membership. (Global Learning Opportunity course)

While each First Year Seminar course engages a unique topic examined from multiple perspectives, each course also introduces students to a common set of transferable skills. As such, First Year Seminar facilitates student engagement with: fellow students, the university, the community, and the common reading; essential college-level research and information literacy skills; and the habits of rigorous study, intellectual growth, and lifelong learning.

1.2 Breakthroughs and Controversies in Science and Mathematics Course Description

Human beings are driven to explore ourselves and the world around us and to ask how things work. Today it may be difficult for us to imagine how mysterious the inside of a living person seemed only about 100+ years ago, when x-rays were discovered in 1895. Amazing breakthroughs have been made since then, such as the invention of the atomic bomb, penicillin, cloning and artificial intelligence.

In this course we will look at the process of discovery as well as the implications of recent breakthroughs and developments. We will choose topics and explore these issues using articles and videos. We might choose to debate climate change, string theory, or the 2005 president of Harvard University's comments about the innate ability of women in mathematics. We could explore the ethics of biodiesel or unbreakable codes, and whether we still need to learn multiplication tables.

We will delve into diverse and opposing viewpoints on many issues as we discuss current scientific consensus. In this context we will focus on what science and mathematics is, strategies for success in these fields, ethical and philosophical considerations, public perceptions, applications to daily tasks, and the relationship of science and

mathematics to American competitiveness and the global economy. We'll also think about a series of interrelated questions: What is truth? When are we convinced? What are the consequences of certain truths? What is the role of chance and probability? The only prerequisite for this course is an open mind.

1.3 Required Resources and Materials

- *TAKING SIDES: Clashing Views in Science, Technology, and Society* by Thomas A. Easton (rental)
- Fall 2017 Common Reading Book: *One Amazing Thing* by Chitra Banerjee Divakaruni
- You will need regular access to the class webpages including the calendar <http://cs.appstate.edu/~sjg/class/fs/f17.html>, which is considered part of this syllabus, ASULearn, and the library pages, including the Library Modules. You can access these on and off campus (some require your ASU login).
- You will need copies of your work to turn in.
- If you already have an *i-clicker*, the official university clicker, then bring that to all classes. If not, you can pick one up at the start of each class, but must return it by the end of each class. The mathematics department is providing these for our use, but we must share them with other classes.

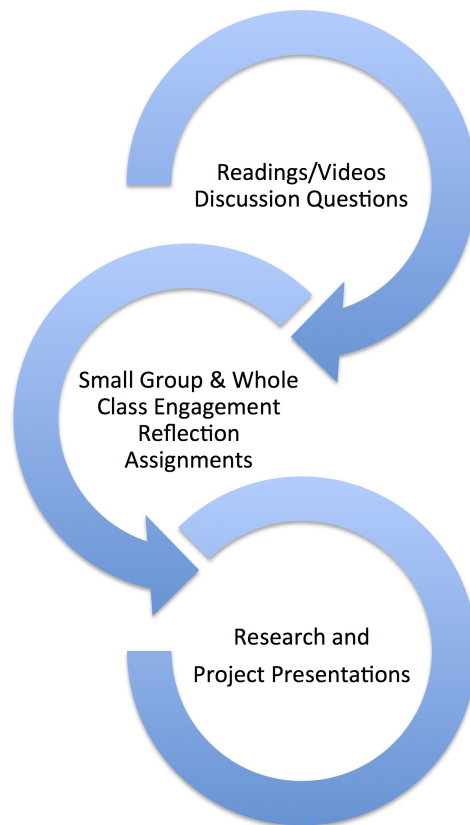
1.4 Academic Affairs Policies

We adhere to the University-wide syllabus and policy statements:

<https://academicaffairs.appstate.edu/resources/syllabi-policy-and-statement-information>

1.5 Learning Activities and Grades

We'll be engaging in standards based learning, where success is tied to meeting specific learning goals in assignments, rather than a percentage correct or point system. This will allow you (and I) to identify strengths and weaknesses early in the class. You'll have multiple chances to satisfy each goal and work on any problem areas. Once you have met a requirement, you can focus your energies on the remaining ones. We'll also share successful examples of how classmates have met goals.



We'll employ Star Wars terminology as a metaphor—Padawans are training to one day become a Jedi. Jedi Knight is a rank within the Jedi Order, referring to Jedi who complete their training and pass the Jedi Trials to become full members. Since you have demonstrated proficiency, you have earned a grade in the C range. As a Jedi Master leader you have demonstrated exceptional achievement and earned a grade in the A range.

	missing	Padawan still training	Jedi Knight C	Jedi Master A
Relationship of Active Retrieval (AR) and Learning Goals (LG) to Course Grade				
AR 1: I can make a good faith effort in answering homework questions.			5	9
AR 2: I can produce thoughtful reflections.			2	5
AR 3: I can produce quality projects.			2 attempts 1 proficient	1 proficient 1 outstanding
LG 1: I can examine a single issue from multiple perspectives, e.g. diverse and opposing viewpoints, historical and recent perspectives, local and global connections.			1 reflection 1 project	2 reflections 2 projects
LG 2: I can conduct quality research and summarize what I found.			1 project	1 reflection 2 projects
LG 3: I can analyze the arguments of others and connect them to me, including current scientific consensus.			1 reflection attempt project	2 reflections 1 project
LG 4: I can communicate effectively to produce publication-quality written, verbal and visual work in a logical, organized manner that demonstrates consideration of context, audience, and purpose.			1 reflection 1 project	2 reflections 1 project
LG 5: I can make connections with others and the university through a shared process of inquiry via regular attendance and respectful participation in our classroom community (community membership).			≤ 8 absences and positive participation	regular attendance and positive participation

Since “A Jedi’s training in the Force never ends” [Vodo-Siosk Baas, Jedi Master], class engagement distinguishes between -, regular, or + in the grade. This includes turning in all work due and effectively engaging in course activities. To earn a grade in the B range complete Jedi Knight (C) requirements plus half way to Jedi Master (A). There are two pathways to achieve such a B. One is to satisfy at least 50% of the Jedi Master (A) requirements (4 of the 8 AR/LG requirements) with the others at the Jedi Knight (C) level. The other is to surpass every one of the Jedi Knight (C) requirements at the halfway mark between Jedi Knight and Jedi Master (for example, for AR 1, 7 is halfway between 5 and 9). The D range is half way to Jedi Knight.

***Accommodations in the determination of the final grade will be made for extenuating circumstances that are documented to prevent you from turning in work early or on time, including the level of achievements in the learning targets.

1.6 Active Retrieval (AR)

One of the most striking research findings is the power of active retrieval... and that the more effortful the retrieval, the stronger the benefit. [Make It Stick: The Science of Successful Learning by Peter C. Brown, Henry L. Roediger III and Mark A. McDaniel]

Homework Question Assignments are responses to targeted questions that relate to course goals. These are low stakes assignments designed to help you engage with the material. I will mark whether you attempted the questions, and a good faith effort is all I ask for at this point. Unless otherwise stated, they are due 30 minutes prior to class on ASULearn, before our class discussion. There is no late work accepted, but the lowest

are dropped. Prepare to share your ideas during class, so you may wish to bring a copy of your responses with you.

Class Engagement includes attendance, which is required, turning in all work due, and active learning in small groups and the whole class. You must be prepared for each class and check the main web page regularly for homework. We'll engage in diverse engagement techniques during class. One example is clicker questions, a combination of knowledge questions and opinion-based questions. As research indicates, the act of clicking itself does not result in learning, instead it is the small group and larger class discussions that occur afterwards that are essential. I will often ask you to talk to a neighbor you haven't already talked to about the issue before coming back together as a class. The anonymity of clickers allows us to gauge class attitudes about controversial issues and check in to see whether the class understood the material. Small groups also engage material by completing worksheets, such as those analyzing and critiquing content, and working on creative solutions to real-life problems.

A Jedi trusts the Force and at first seeks other ways to resolve problems: patience, logic, tolerance, attentive listening, negotiation, persuasion, calming techniques.

[Luke Skywalker in *Lightsabers* by Kevin J. Anderson and Rebecca Moesta]

Effective engagement in our classroom community includes active listening to others as well as respectful and meaningful participation and a willingness to complete activities. Asking and answering thought provoking questions, coming up with creative or fun ways of thinking about the material, utilizing office hours and ASULearn forums, and explaining the material to others are some examples of positive participation. However, performing activities that detract from the professional classroom environment or distract other students or me (I'm very easily distracted) will count as a partial absence. Use of interactive technology is allowed only when it is related to our class. Otherwise put cell phones away or place them face down and set them to vibrate. No texting during class—if there is an emergency, please leave the room and return when you are finished. Many activities and class discussions are designed to be completed during class. Thus, attendance is required at ALL classes. If you must be late to a class, or must leave early, then do still attend.

Reflections are typed or spoken expositions, typically the equivalent of 1 page long, single-spaced text. They are due after readings, class discussions and activities on the topic. The rubric is on the course webpages. Aside from the topic, the focus is flexible so that you can follow up on and make connections to your own interests. **For each reflection, list any learning goals you want me to assess.** Each individual reflection may address any, all or none of the course learning goals. You will receive feedback from peers and myself and will have a chance to revise the first couple of reflections. There is no late work accepted, but the lowest are dropped.

Projects These publication-quality typed projects articulate research and analysis. In the first project you will create a historical timeline and annotated bibliography that explores the interesting and important scientific and/or mathematical breakthroughs and controversies. In the second research project, you will research an unsolved scientific question or problem of interest. You will conduct a literature review and create a list of references, you will summarize conflicting viewpoints related to the problem, and you will explore scientific consensus as well as your own ideas. You will present your projects in poster session formats. The rubrics are on the course webpages.

1.7 Learning Goals (LG)

Critical and Creative Thinking, Multiple Perspectives, GLO, and Local to Global (LG 1, LG 3)
TAKING SIDES: Clashing Views in Science, Technology, and Society is described as a book that “presents current controversial issues in a debate-style format designed to stimulate student interest and develop critical thinking skills.”

Each “side” is a yes or no exposition connected to topics like “Will the Search for Extraterrestrial Life Ever Succeed?” Our class focuses on two items from GLO:

- analyze a single issue from multiple perspectives [GLO 2]
- contested assumptions and intellectual debates across the globe [GLO 1]

We examine multiple perspectives in debates related to issues like human contributions to global climate change, evolution, whether fractions are the route of all our math evils, and more via research and evidenced-based debate. Before a class debate students turn in answers to questions like: “For each side in the reading, what are the most compelling arguments?” We also explore a variety of types of consensus perspectives—via in class *i-clicker* questions on class beliefs as well as a focus on what the preponderance of published evidence currently points towards and if there is a consensus position from the scientific community around the world. Hence we move beyond the controversies. The students also reflect on class discussions and activities in written format, as they explore their own perspectives. In the final exam research sessions, students present an unsolved problem or question along with a list of “yes” and “no” ideas that are researched and cited.

As a specific example of multiple perspectives, during one course, one newspaper article the students chose to discuss was titled *How Baboons Think (Yes, Think)*. The article described a number of experiments in which researchers recorded baboon sounds and replayed them to baboons in their natural habitat. In the context of the related discussion, we highlighted:

- Sample size, randomness, and proof
- Whether the presence of humans in the area might impact the experiment and the relationship to our previous discussions on the Heisenberg uncertainty principle
- The differences and similarities of recorded sounds and natural sounds
- Whether we could measure thought in a baboon in a fair and neutral manner when it is common for us to humanize other objects and animals
- That we might like to see related results from medical imaging, and what highlighted areas on a brain scan might or might not tell us about the psychology and thought process of an animal
- Connections to religious beliefs, evolution, and *Planet of the Apes*
- The ethical treatment of animals and the economic implications of preserving natural habitats

We’ll consciously highlight the local to global theme throughout the semester. Some examples include:

- Geometry of the earth and universe (as global as we can get!)
- Local mathematical knowledge being used (or misused) to obtain global results
- Science and mathematics in the U.S. as skills needed for global economic competitiveness
- Identifying methods, discoveries and breakthroughs of diverse cultures and countries
- Scientists and mathematicians from all over the world routinely work together and use each other’s work
- What we can do personally to respond to issues and impact the world around us

You’ll include diverse scientists from around the world as well as their contributions in your timeline project. Here is text from a student timeline on diabetes:

1923—Sir Frederick Grant Banting, a Canadian physician, and John James Rickard MacLeod a Scottish physician, received the Nobel Prize in Physiology or Medicine for their successful isolation of insulin. This specific prize they received is controversial because American medical student Charles Harold Best was also successful at isolating insulin alongside these two physicians, yet he did not receive the Nobel Prize.

As another example, during a class discussion on climate change, we discuss the fact that the preponderance of current published evidence points toward human contributions to global climate change and that this consensus position is also the position of the Academies of Science from 80 countries around the world.

Information Literacy and Research (LG 2) We will engage in increasingly sophisticated research activities on historical and unsolved questions in mathematics and science, and on living scientists and mathematicians. Library research and academic integrity will be addressed as a fundamental part of the course. We will conduct various research activities, such as:

- Library Modules, specially designed for this class, focus on the steps in the research process and provide an overview of library resources and services, including Research as Inquiry, Searching is Strategic, Authority is Constructed and Contextual, and Information has Value.

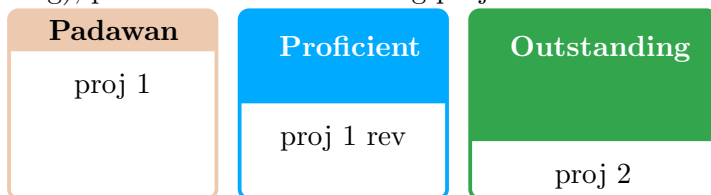
- During one class period, teams will work together on problems similar to those used for the Consortium of Mathematics and Its Applications modeling contests, many of which would also be suitable for enhancing into research projects. You will be given a limited amount of time to work on the problems, and then you will reflect on the research process and process of discovery. Later you will follow up on a related question by conducting online research.
- You will research a professor’s articles in the library databases. You will interview a professor on campus about the controversies and breakthroughs in their research.
- Teams will search for abstracts and bibliographies that are listed in the library databases. We will also discuss the IRB process and research opportunities. We will learn to collect and analyze information, and differentiate between scholarly and other articles. In the research projects you will apply what we have learned about research and employ a variety of strategies from various disciplines.
- Research in course projects and reflections

Communicating Effectively (LG 4) We will practice written, verbal and visual work during class discussions and in homework and project assignments. Successful communicators interact effectively with people of both similar and different experiences and values. ASU’s General Education Program prepares students to employ modes of communication that can help communities reach consensus or respectful disagreement, which is particularly appropriate given the them of our class on breakthroughs and controversies in science and mathematics.

Building Connections and Community Membership (LG 5) In order to build connections to your courses, faculty, and the university, you will reflect on your own process of discovery and its implications in classes and you will also interview a professor on campus about these issues, and share them with the rest of the class. We will also reflect on the purpose of education as well as scientific research on effective learning in order to facilitate the habits of rigorous study, intellectual growth, and lifelong learning. You will be required to attend and reflect on out-of-class university sponsored experiences. First year seminar is given ticket money for a university sponsored performing arts event. *Radium Girls* is most closely aligned with our UCO 1200, so you’ll choose the time that works best for you, and I’ll arrange for the complimentary tickets. We’ll all attend a performance. We will also research and advertise the mathematics and science activities at the university. There are many related places on campus, such as faculty and departmental labs, the F. Kenneth and Marjorie J. McKinney Geology Teaching Museum, the Math and Science Education Center, the Small Wind Research and Demonstration Site, and the Dark Sky Observatory and Cline Visitor Center. In order to build connections among the students, most of class time will be used to engage in group activities or class discussions and reflections. We will also explore the responsibilities of community membership, including ethical behavior and actions in a variety of contexts, such as the ethics related to scientific research, including proper citation.

1.8 Sample Jedi Paths

Here is a sample path for AR 3. With the help of revisions on Project 1, this student has met Jedi Master (A) targets for the course project requirement (1 proficient project, 1 outstanding project). Padawan projects (still training), proficient and outstanding projects are defined on the project rubrics.



For reflections, generally you should be aiming for a thoughtful reflection as defined on the reflection rubric (AR 2), plus one or two additional learning goals. For this student, they met LG 1 on reflection 1, and additionally AR 2 and LG 4 when they turned in revisions:

Padawan

reflection 1: AR 2, LG 4

Proficient

reflection 1: LG 1

Proficient

reflection 1 revision: AR2,
LG 1, LG 4

Here is a sample path for the reflection component of the course:

Sample of Satisfying Reflection Requirements	<div style="border: 1px solid green; padding: 5px; text-align: center;"> <p>Jedi Master</p> <p>A</p> </div>
AR 2: I can produce thoughtful reflections.	5 total: reflection 1 revisions reflection 2 revisions reflection 4 reflection 5 reflection 6
LG 1: I can examine a single issue from multiple perspectives, e.g. diverse and opposing viewpoints, historical and recent perspectives, local and global connections.	2 total: reflection 1 revisions reflection 4
LG 2: I can conduct quality research and summarize what I found.	1 total: reflection 3
LG 3: I can analyze the arguments of others and connect them to me, including current scientific consensus.	2 total: reflection 2 revisions reflection 5
LG 4: I can communicate effectively to produce publication-quality written, verbal and visual work in a logical, organized manner that demonstrates consideration of context, audience, and purpose.	2 total: reflection 1 revisions reflection 6

Notice that the student concentrated on research (LG 2) for reflection 3 and earned credit for that goal even though it wasn't a thoughtful reflection overall as it lacked personalization. That is fine in this model because there are enough thoughtful reflections overall.

1.9 Where to Get Help and Additional Policies

Check the main webpage often for homework and for access to the other class web pages. ASULearn is the easiest way to ask a question outside of class and office hours. You are responsible for reading all posts from me. I prefer that you use office hours since it is easier to discuss material in person, but if you can not make them, then ASULearn is a great alternative. If the university cancels classes, check the class webpages for updated info, which may include plans for the missed class such as readings, problems, online meetings, Chat, and/or Forum sessions in ASULearn. Homework may still be due. Snapshots from your phone attached onto the private ASULearn forum are acceptable, for example. If there is some reason you must miss a class, then keep me informed, with any appropriate documentation, and obtain the assignment and class activities from the web pages to turn the work in early or on time (you can send it with another student to class, slide it under my office door sometime before I leave for class, or even turn it in on ASULearn if need be, but I prefer printed work). These include responses to i-clicker questions and other class activities.

As per the University-wide Statement on Student Engagement with Courses you can expect to spend (on average) 2-3 hours outside of class for each hour in class. You are responsible for all material covered and all announcements and assignments made at each class, whether you are present or not. You are also responsible for announcements made on the web pages, so check them often. Your other time outside of class should be spent reviewing course material, completing homework assignments, reflections and projects, and in office hours.

I encourage you to talk to me often in class, office hours, and on the ASULearn forums. Office Hours are in 326 Walker Hall 262-2363 M 1:20-3:50, T/H 1:45-3:15 and I am always happy to help. Asking questions, and explaining things to others, in or out of class, is one of the best ways to improve your understanding of the material. This course is to be an environment in which everyone feels comfortable asking questions, making mistakes, offering good guesses and ideas, and is respectful to one another. I also want you to be informed about your choices regarding what you tell me about certain types of sensitive information. For example, instances of triggering can happen when somebody is exposed to controversial topics. In situations where students disclose experiencing an act of interpersonal violence to their instructor, faculty are required to report what students tell us to the campus Title IX Coordinator, who then reaches out to the student by email offering support services. I care about you and want you to get the resources you need. I'm happy to talk with you if you decide you want that, but please be aware that if instead you'd like to explore options with someone who can keep your information totally confidential, I highly recommend the Counseling Center at 828-262-3180. They offer walk-in hours as well as after-hours coverage: <http://counseling.appstate.edu>.

- Appalachian Cares is a place to find updates about matters of student health and safety. It also functions as the most up-to-date clearinghouse of information, resources and support available. <http://appcares.appstate.edu/>.
- The University Writing Center (UWC) offers free services to students, faculty, and staff of Appalachian State University and the Boone community: <http://writingcenter.appstate.edu/>
- The library offers Research Advisory Program (RAP) sessions. <http://library.appstate.edu/gethelp/rap>
- The Learning Assistance Program provides five core services. Two services, University Tutorial Services and Academic Strategy Instruction, are offered to all undergraduate students, and three services, ACCESS, Student Support Services, and Academic Services for Student Athletes, serve specific groups of students identified as needing comprehensive support. In Fall 2016, the ASU-R program joined the Learning Assistance Program. <http://lap.appstate.edu/welcome-learning-assistance-program-1>
- AppSync is your one-stop connection to engagement and leadership opportunities at Appalachian State. <https://appsync.appstate.edu/>

You should explore the course material and write out your thinking in a way that can be shared with others. Focus on your own ideas. When writing up work, be sure to give acknowledgment where it is due. Submitting someone else's work as your own (PLAGIARISM) is a serious violation of the University's Academic Integrity Code, which defines: "Plagiarism includes, but is not limited to, borrowing, downloading, cutting and pasting, and paraphrasing without acknowledgement, including from online sources, or allowing an individual's academic work to be submitted as another's work." Use of interactive technology is allowed only when it is related to our class. Otherwise put cell phones away and set them to vibrate. Photos or video or audio recordings may not be taken in class without prior permission. Food and beverages are allowed as long as they aren't distracting, but e-cigs, chewing tobacco/spit cups and other products are not allowed.

You should strive to turn in work of publication quality in your research projects: neat and easy to read, proper grammar and spelling, correct units, well-organized, and a demonstration of your mastery of the subject matter. Future employers and teachers will expect this quality of work. Moreover, although submitting work that is publication quality requires "extra" effort, studies have shown that the effort you expend in clearly explaining your ideas solidifies your learning. In particular, research has shown that writing and speaking trigger different areas of your brain. By communicating your ideas to others—even when you think you already understand them—your learning is reinforced by involving other areas of your brain.

In this course, you will be challenged with questions and concepts that you have never seen before. I do not expect you to be able to solve all the issues. Instead, I want to see what you can do on your own. Out in the real world, this is important, since no matter what job you have, you will be expected to seek out information and answers to new topics you have not seen before. This may feel uncomfortable and frustrating. I understand this and want to help you through the process. In this class, just like in the real world, you are not expected to face your work alone. I encourage you to talk to me and each other often in class, office hours, and the forums. I am always happy to help you, and will try to give you hints and direction to help you understand the material. At times though, to encourage the exploration process, I may direct you to rethink a question or concept and to

come back to discuss it with me again afterwards. This occurs when I believe that the struggle to understand is imperative for your deep understanding of the material.

1.10 Advice from Previous Students

- Keep up with the schedule online with your assignments for next class period.
- I enjoyed all of the discussion and the work load isn't too bad.
- Join in on the discussions
- Make sure you do the work assigned!
- Do your work and come to class.
- Do not wait to do the projects till the last night.
- Do the readings for class
- Participate in class everyday
- Make reflections and homework questions very thorough
- This course is a fun course to take for your FYS. I would recommend taking the projects more seriously than I did; after the first project I found out how much they can hurt your grade.
- I would suggest taking the time to do the work, and not waiting until the last minute. If you do the work, you will get a good grade in this course.
- Participate every class.
- Do not procrastinate on the research projects and keep a regular checking period of the syllabus. Also, have an open mind and participate in class. It makes it fun. honestly just work hard
- read the material before the night prior to class.
- Dr. Sarah is a great professor and you will definitely enjoy the class. Make sure you turn in your assignments on time and that they are completed (there really isn't that much work).
- Even if you are quiet, try to say something in almost every discussion.
- PARTICIPATE
- Procrastination kills.
- I would tell them that this class is interesting because you get to choose what you talk about in debates you just have to participate

1.11 Instructor Bio

My PhD is from the University of Pennsylvania in the Riemannian geometry of orbifolds. I am a full Professor of Mathematics, and I am also an affiliate of Gender, Women's and Sexuality Studies, investigating the connections between mathematics and society. For instance, I co-edited the 3-volume Encyclopedia of Mathematics & Society, which was named a "Best Reference" by Library Journal. My interactive mathematics lecture has been distributed on approximately one million DVDs worldwide as a 25-minute DVD extra for the 20th Century Fox Futurama movie Bender's Big Score. I've spoken about the impacts of scientific popular culture representations on NPR's Science Friday and all over the country, and I've won several teaching awards. I am married to the bassist Joel Landsberg. In our spare time, we like to travel, hike and conduct genealogy research. In addition to my own personal genealogy, I like to give back to the broader community, and in this context, I am affiliated with ASU's center for Judaic, Holocaust and Peace Studies. Some of what I like about mathematics is also what I enjoy about genealogy—the sense of exploration, discovery and aha moments that come with lots of patience and effort.

1.12 Acknowledgements

Star Wars TM and © Lucasfilm Ltd., Twentieth Century Fox, Walt Disney and its companies. For educational use only. I adapted the idea from my friend Amy Ksir at the Naval Academy.