CARTOGRAPHY & GIS (GEOG 381/571)

New Mexico State University
Department of Geography

SPRING 2017

Lecture: Tuesdays & Thursdays, 8:55-10:10; Breland Hall 185
Lab M1A: Mondays, 11:30-14:00; Breland Hall 192; T.A.: Kris
Lab M1B: Thursdays, 14:30-17:00; Breland Hall 192; T.A.: Kris
Lab M1C: Wednesdays, 9:30-12:00; Breland Hall 192; T.A.: Kris

Professor: **Dr. Michaela Buenemann**
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Office Hours: Tue, 10:15-12:00 and 13:30-15:30; Wed, 10:00-12:00 and 13:00-16:00; Thu, 10:15-10:45 and 14:30-15:15. Sign up on Dr. B.'s door to ensure her time is all yours! If the 10 office hours she is offering conflict with your schedule, please contact her to make an appointment.

T.A. **Kristopher Burke**
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Office Hours: Tue, 13:00-14:00; Wed, 12:00-13:00, Thu, 13:30-14:30, by appointment.

COURSE DESCRIPTION

This course introduces you, through lectures and labs, to the fundamental concepts and methods of thematic cartography. Rather than to focus on the analysis and interpretation of maps (GEOG 281: Map Use), this course emphasizes topics related to the actual design and production of maps and thus presents issues that are at the heart of Geographic Information Science and Technology (GIS&T), which includes Geographic Information Systems (e.g., GEOG 481/578: Fundamentals of Geographic Information Systems) and Remote Sensing (e.g., GEOG 373/573: Introduction to Remote Sensing and GEOG 473/582: Advanced Remote Sensing). The fundamental principles of cartography (e.g., scale, projections, symbolization) that we will introduce to you in the lectures have changed little over the last few decades. The discipline has moved increasingly toward automation, however, and we will acknowledge this trend through assignments that require you to apply concepts discussed in the lectures using a commercial software package (ArcGIS) in the labs. That is, we will provide you with a solid foundation of cartographic principles in the lectures and introduce you to the computer-assisted application of those principles in the labs.

STUDENT LEARNING OUTCOMES

Upon completion of this course, you should be able to:
1. explain key cartographic concepts;
2. evaluate map quality based on a series of criteria; and
3. create functional and aesthetically pleasing maps.

COURSE STRUCTURE

This is a **fast-paced course with a steep learning curve.** The course introduces a variety of interrelated concepts, terms, and principles relevant to cartography, geographic information systems, remote sensing, geography, and other sciences concerned with mapping. It also introduces you to ArcGIS software. We will deal with new concepts and techniques every week and each is treated more or less separately in the readings listed in the tentative course outline below as well as in the labs. However, you can only become an excellent cartographer (or any kind of geospatial expert for that matter), if you understand all concepts and techniques discussed in this course and how they relate. That is, you cannot create a high-quality map if you understand the principles of thematic map symbols only; you also need to be able to choose an appropriate scale for your map, apply statistical concepts properly, and so forth. It is thus crucial that you always keep up with the lectures and labs by preparing for lectures and labs, actively participating in class meetings, and reworking all class materials. **WE** will do our very best to **FACILITATE LEARNING** (i.e., to help you achieve the learning outcomes stated above)—we will always prepare and present class materials to the best of our abilities; give you tasks that will help you better understand key concepts and techniques; and encourage cooperative learning and class discussions. **YOU** are **RESPONSIBLE** for **LEARNING ITSELF**.

COURSE MATERIALS

Website: Course materials (e.g., lectures, labs, grades) can be found at https://learn.nmsu.edu/. To access course materials, simply log in to your Canvas account and click the link for this course. The website is a key element of this course and you are required to review its contents regularly. If you encounter problems related to the website, please contact us immediately.

E-mail: Official NMSU communication to you will come through your NMSU e-mail account. Access your NMSU e-mail frequently, or forward it to your current use address, as your success in college may ride on your ability to respond quickly. To guarantee a response to your emails, always a) begin your emails with a proper greeting that includes the name of the person/s you are emailing; b) conclude with a closing that includes your name; and c) use proper spelling, grammar, and punctuation. Unless we are away from the office with limited access to email, we will respond to your emails within one business day. Similarly, we expect you to respond to our emails in a timely manner.

Textbook: You need to acquire a textbook for this course and have three options concerning the book itself: you buy/rent 1) the required text (**Dent, B. D., J. Torguson, and T. W. Hodler. 2009. *Cartography: Thematic Map Design*. 6th ed. Boston: McGraw-Hill**), 2) an earlier edition of the text, or 3) any introductory cartography book of your own choice. If you choose a book other than the required book, you are responsible for correlating the content of your chosen

book with the required reading assignments. Note that you may be able to check out the book from a library and that you may be able to purchase the book for discounted prices at used bookstores, thrift stores, or online at amazon.com, barnesandnoble.com, or textbookland.com.

ArcGIS Software: We will use ESRI's ArcGIS software to make maps as part of the lab component of the course. The software is available on all computers in the lab room. In addition, to give you maximum flexibility in completing the labs, we will provide you with a free, fully functional, one-year license of the software for use on your personal computer.

GRADING

Your final course grade is determined by the points you accrue out of a possible 1000 points:

Exams (× 4):	330 points	33%	**1,000 Points (100%)**
Labs (× 12):	360 points	36%	
RATs (× 25):	250 points	25%	
MCPs (× 18):	60 points	6%	

Graduate Students: Upon completion of this course, the number of points listed above for undergraduate students will be adjusted to account for only 80 % of your final grade. You will earn the remaining 20 % of your final grade through completion of a term project.

Your final course letter grade will be based on the following scale:

A (4.0)	95-100%	**B (3.0)**	84-86%	**C (2.0)**	74-76%	**D (1.0)**	64-66%
A- (3.7)	90-94%	**B- (2.7)**	80-83%	**C- (2.0)**	70-73%	**D- (1.0)**	60-63%
B+ (3.3)	87-89%	**C+ (2.3)**	77-79%	**D+ (1.0)**	67-69%	**F (0)**	< 60%

Individual assignments and tests will not be curved (↑ or ↓). We *may* make adjustments of the final letter grade after an assessment of the class curve at the end of the term. We consider class participation, attendance, and improvement over the term as justification for discounting a grade that is uncharacteristically lower than others.

An **I (Incomplete)** grade will be assigned only if you are unable to complete the course due to circumstances beyond your control (e.g., documented illness or documented death or crisis in your immediate family) that develop after the last day to withdraw from the course. Job-related circumstances are generally not appropriate grounds for assigning an I. An I grade will not be used to avoid assigning of D, F, U, or RR grades for marginal or failing work.

Exams: There will be four exams. Exams 1, 2, 3, and 4 will account for 5% (50 points), 7% (70 points), 9% (90 points), and 12% (120 points) of your final course grade, respectively, and thus for a combined total of **33%** (330 points) of your final course grade. Each exam will be cumulative, assessing your learning since the beginning of the semester. Exam 4, for which you will receive detailed instructions during the first two weeks of the semester, will be a comprehensive take-home exam, requiring you to create an original and both functional and aesthetically pleasing bivariate quantitative thematic map. All other exams will be written on paper and in class on the exam days indicated in the Tentative Course Outline below. All exams will be individual efforts. **Make-up exams:** If you have a legitimate excuse for a university-sanctioned activity or work-related event that will cause you to miss an exam, contact us prior to the official exam time so that we can schedule a make-up exam, and provide us with written documentation prior to or on the day of your make-up exam. If you have to miss an exam due to illness, contact us as soon as possible so that we can schedule a make-up exam, and provide us with written documentation on the day of the exam. If you fail to follow these guidelines or if you miss an exam for other reasons, you will receive 0 points for the exam.

Labs: There will be twelve lab exercises, each accounting for 3% (30 points) of your final

course grade or for a combined total of **36%** (360 points), and each contributing in some way to the skillset required for the successful completion of the final exam. The labs will thus be crucial to your overall success in this course. There are deadlines for submission of maps and related products in the real world. To reinforce this and to teach you to work under these restrictions, late submissions will be given a score of 0 points. Exercises are to be turned in via Canvas not later than the beginning of your lab the week after they were assigned. This means you should allow extra time for glitches in computer hardware and software. Should you be unable to submit your work on time, submit it nonetheless and as soon as possible after the deadline: you will learn from completing the lab and you will receive valuable feedback for your work. If you are unable to submit your work on time due to extenuating circumstances, contact us as soon as possible: we will work with you to help you succeed. We invite you to collaborate with others to solve lab problems, but your lab submissions must clearly be your own work.

Muddy & Clear Points (MCPs): MCPs are written notes summarizing aspects of the readings that were unclear and aspects of the readings that made perfect sense to you. There will be eighteen MCPs this semester; sixteen of these will account for 0.3% (3 points) each and two (#17 and #18) for 0.6% (6 points) each. Collectively, the MCPs will thus determine **6%** (60 points) of your final course grade. MCPs are credit opportunities for you to reflect on your understanding of the class materials. They should serve as an incentive for you to prepare the readings for class. At the same time, they allow your instructors to tailor each class meeting specifically to your needs, with emphasis on muddy points and no or only short discussion of the clear points. MCPs may be handwritten or typed, are individual efforts, and are due on paper at the beginning of class on the days indicated in the Tentative Course Outline below.

Readiness Assessment Tests (RATs): There will be twenty-five RATs this semester, each accounting for 1% (10 points) of your final course grade. Collectively, the RATs will thus determine **25%** (250 points) of your final course grade. As implied in the Tentative Course Outline below, each RAT typically covers materials already discussed in class (materials to be reworked) as well as materials to be discussed in class on the day of the RAT (materials to be prepared for class, i.e., readings noted in the Tentative Course Outline below). All RATs will be team-based (see below) and written on paper during class on the days indicated in the Tentative Course Outline below. RATs will be graded by the following class meeting. If your group has any issues with a graded RAT (e.g., ambiguous task), your group may prepare a written appeal and submit it to us. If we feel that your appeal has merit, you will receive credit accordingly.

Teams & Peer Evaluations: Collaboration is an important component of most jobs and tends to be very rewarding. We thus encourage collaboration throughout the semester. To facilitate the process, you will be divided into teams, each comprised of about five students. Each team will be made up of a diversity of individuals, but different teams will be comparable to each other (e.g., each team will be composed of roughly the same number of geography and non-geography majors). Members of every individual team will complete RATs as just that—a team. However, while each team member will initially receive the same grades as all other team members, adjustments of each team member's grades (upward or downward) will be made based on peer evaluations that assess an individual's contribution to the success of the team (e.g., preparedness, reliability, participation in discussions, ability to compromise). It is thus in your own best interest to always be prepared and contribute as much as possible to teamwork and discussions.

Learning Outcomes (LOs): Many LOs (i.e., descriptions of things you should be able to do) could be formulated for each topic, but some are particularly crucial to help you acquire the three

big LOs of this course (p. 2). To help you stay focused on the important issues, we will provide you with a set of crucial LOs for each topic. Consider these LOs as your **study guide.**

Term Project (Grad Students Only!): Grad students will be required to submit a term project as part of their course work (20% of final grade). Guidelines for the term project are outlined in a separate document. If you are a graduate student, please contact me ASAP for details.

Further details regarding each of the above grade components will be provided to you in class, lab, and/or on the course website.

POLICIES, CODES, ETC.

Students with Disabilities. Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act Amendments Act (ADAAA) covers issues relating to disability and accommodations. If you have questions or need an accommodation in the classroom (all medical information is treated confidentially), contact: Trudy Luken, Director; Student Accessibility Services (SAS) - Corbett Center, Rm. 208; Phone: (575) 646-6840 E-mail: sas@nmsu.edu; Website: http://sas.nmsu.edu/

Non-Discrimination. NMSU policy prohibits discrimination on the basis of age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, retaliation, serious medical condition, sex, sexual orientation, spousal affiliation, and protected veterans status. Furthermore, Title IX prohibits sex discrimination to include sexual misconduct: sexual violence (sexual assault, rape), sexual harassment and retaliation. For more information on discrimination issues, Title IX, Campus SaVE Act, NMSU Policy Chapter 3.25, NMSU's complaint process, or to file a complaint contact: Lauri Millot, Title IX Coordinator; Agustin Diaz, Title IX Deputy Coordinator; Office of Institutional Equity (OIE) - O'Loughlin House, 1130 University Avenue; Phone: (575) 646-3635 E-mail: equity@nmsu.edu; Website: http://www.nmsu.edu/~eeo/

Other NMSU Resources. NMSU Police Department: (575) 646-3311, www.nmsupolice.com; NMSU Police Victim Services: (575) 646-3424; NMSU Counseling Center: (575) 646-2731; NMSU Dean of Students: (575) 646-1722; For Any On-Campus Emergencies: 911

Code of Academic Integrity. Enrollment in this course and acceptance of this syllabus is your **contract** constituting acceptance of all University policies regarding academic integrity, including but not limited to cheating and plagiarism. You are expected to comply fully with the NMSU Honor Code as presented in the Student Handbook (http://studenthandbook.nmsu.edu/). Students who are judged to be guilty of academic dishonesty (http://studenthandbook.nmsu.edu/student-code-of-conduct/academic-misconduct/) on any graded class component will receive no points for that component, and we reserve the right to consider more severe penalties such as failure of the course and referral to the Dean and Student Judicial Affairs.

Absence Policy. Absences due to University-sanctioned activities, work-related events, holidays or special events observed by organized religions, or illness will be excused, if you provide us with official written documentation explaining your absence. We don't really have any additional absence policies. Just keep the following in mind: learning is your responsibility and, if you miss a lecture or lab, you will have to figure out how to "make it up;" your peers will evaluate you in terms of your contributions to the success of your team and the class and these

evaluations will be used to convert team grades to individual grades.

Withdrawal. Withdrawal from this course is solely your responsibility; we will not drop you from this class under any circumstances. If you no longer wish to be enrolled in this course, you must withdraw from it. If you are still on the class roll at the end of the semester, you will receive a grade based on the work submitted.

What you can expect from us. We will be available in class, during office hours and scheduled appointments, and via email to respond to any questions or concerns you may have**.** Don't be shy and contact us as soon as ambiguities, problems, or concerns arise! We will take all of your concerns seriously and respond to you as soon and as specific as possible. We will address any issues that are of importance to all students in class and on Canvas. We will do our very best to always be prepared for class, grade assignments fairly, and return your work promptly (within one week). We reserve the right to change scheduled lectures, exams, and assignments. Any changes made will not adversely affect your workload or grade.

What we expect from you: Enrollment in this course and acceptance of this syllabus is your **contract** constituting acceptance of ALL New Mexico State University policies and codes as well as ALL specific policies outlined in this syllabus. We expect you to be on time for all class-related activities, submit all tasks as instructed, and always show "good" behavior toward both your instructor and peers. **HAVE FUN**!

TENTATIVE COURSE OUTLINE

Week	Date	Topic	Due: At Home | In Class * Pages in Dent et al. 2009
PART I: THEMATIC MAPPING ESSENTIALS			
1	01/19	**Welcome & Ice Breaker**	
2	01/24	**History of Cartography (1)**	✓ Study Syllabus & Get Textbook ✓ MCP #1 (Syllabus & Topic 1) ✓ RAT #1 (Syllabus & Textbook)
	01/26	**Principles of Cartography (2)**	✓ Reading #1: 1-11, 13-16, 18-20* ✓ MCP #2 (Topic 2) ✓ RAT #2 (Topics 1 & 2)
	Lab	***No Lab***	
3	01/31	**Map Scale & Generalization (3)**	✓ Reading #2: 11-13, 16-18, 33-35, 76-78* ✓ MCP #3 (Topic 3) ✓ RAT #3 (Topics 2 & 3)
	02/02	**Coordinate Systems (4)**	✓ Reading #3: 23-33* ✓ MCP #4 (Topic 4) ✓ RAT #4 (Topics 3 & 4)
	Lab	***Lab #1: Getting Started with ArcGIS***	
4	02/07	**Map Projections (5)**	✓ Reading #4: 37-61*

		Peer Evaluation #1	✓ MCP #5 (Topic 5) ✓ RAT #5 (Topics 4 & 5)
	02/09	**Nature of Geographic Data (6)**	✓ Reading #5: 63-70* ✓ MCP #6 (Topic 6) ✓ RAT #6 (Topics 5 & 6)
	Lab	***Lab #2: Map Scale & Generalization***	✓ Lab #1
5	02/14	**Thematic Map Symbols (7)**	✓ Reading #6: 70-78* ✓ MCP #7 (Topic 7) ✓ RAT #7 (Topics 6 & 7)
	02/16	Review	✓ Rework Topics 1-7 ✓ RAT #8 (Topics 1-7)
	Lab	***Lab #3: Map Projections***	✓ Lab #2
6	02/21	**Exam #1 (Topics 1-7)**	✓ Prepare for Exam #1
	02/23	**Descriptive Statistics (8)**	✓ Reading #7: 80-85* ✓ MCP #8 (Topic 8) ✓ RAT #9 (Topics 1-8)
	Lab	***Lab #4: Digitizing & Data Entry***	✓ Lab #3
PART II: TECHNIQUES OF QUANTITATIVE THEMATIC MAPPING			
7	02/28	**Data Classification (9)**	✓ Reading #8: 85-98* ✓ MCP #9 (Topic 9) ✓ RAT #10 (Topics 8 & 9)
	03/02	**Choropleth Maps (10)** Peer Evaluation #2	✓ Reading #9: 101-117* ✓ MCP #10 (Topic 10) ✓ RAT #11 (Topics 9 & 10)
	Lab	***Lab #5: Working with Geospatial Data from the WWW***	✓ Lab #4
8	03/07	**Dot Density Maps (11)**	✓ Reading #10: 119-130* ✓ MCP #11 (Topic 11) ✓ RAT #12 (Topics 10 & 11)
	03/09	**Proportional Symbol Maps (12)**	✓ Reading #11: 131-148* ✓ MCP #12 (Topic 12) ✓ RAT #13 (Topics 11 & 12)
	Lab	***Lab #6: Choropleth Maps***	✓ Lab #5
9	03/14	**Exam #2 (Topics 1-12)**	✓ Prepare for Exam #2
	03/16	**Isarithmic & 3-D Maps (13)**	✓ Reading #12: 150-166* ✓ MCP #13 (Topic 13) ✓ RAT #14 (Topics 1-13)
	Lab	***Lab #7: Dot Density & Proportional Symbol Maps***	✓ Lab #6
10	**---**	**Spring Break (03/20-03/24): No Lectures, No Labs**	

11	03/28	**Cartograms (14)**	✓ Reading #13: 168-185* ✓ MCP #14 (Topic 14) ✓ RAT #15 (Topics 13 & 14)
	03/30	**Flow Maps (15)**	✓ Reading #14: 188-200* ✓ MCP #15 (Topic 15) ✓ RAT #16 (Topics 14 & 15)
	Lab	***Lab #8: Isarithmic & 3-D Maps***	✓ Lab #7
PART III: THEMATIC MAP DESIGN & PRODUCTION			
12	04/04	**The Map Design Process (16)** Peer Evaluation #3	✓ Reading #15: 203-223* ✓ MCP #16 (Topic 16) ✓ RAT #17 (Topics 15 & 16)
	04/06	**Principles of Typography (17)** **& Color in Thematic Mapping (18)**	✓ Reading #16: 226-244, 246-264* ✓ MCP #17 (Topics 17-18) ✓ RAT #18 (Topics 16-18)
	Lab	***Lab #9: Cartograms & Flow Maps***	✓ Lab #8
13	04/11	**Analog Cartography (19)** **& Digital Cartography (20)**	✓ Reading #17: 268-278, 280-296* ✓ MCP #18 (Topics 19-20) ✓ RAT #19 (Topics 17-20)
	04/13	Review	✓ Rework Topics 1-20 ✓ RAT #20 (Topics 1-20)
	Lab	***Lab #10: Map Labeling***	✓ Lab #9
14	04/18	Cartography Olympics	✓ Rework Topics 1-20 ✓ RAT #21 (Topics 1-20)
	04/20	**Map Evaluation**	✓ Rework Topics 1-20 ✓ RAT #22 (Topics 1-20)
	Lab	***Lab #11: Your Personal Map #1***	✓ Lab #10
15	04/25	**Map Evaluation**	✓ Rework Topics 1-20 ✓ RAT #23 (Topics 1-20)
	04/27	**Exam #3 (Topics 1-20)**	✓ Prepare for Exam #3
	Lab	***Lab #12: Your Personal Map #2***	✓ Lab #11
16	05/02	**Map Evaluation**	✓ Rework Topics 1-20 ✓ RAT #24 (Topics 1-20)
	05/04	**Map Evaluation** Peer Evaluation #4	✓ Rework Topics 1-20 ✓ RAT #25 (Topics 1-20)
	Lab	***Lab: Take-Home Final Exam Prep***	✓ Lab #12
17	**05/11**	**Take-Home Final Exam Due at 8:00 AM** **"Best Personal Map" Competition & Awards Ceremony, 8:00-10:00 AM**	

DR. B'S SYLLABUS REFLECTIONS

The rationale for a Cartography course in a geography curriculum is simple.
Geographers are concerned with relationships within and among human and environmental systems across space. To discover, analyze, and ultimately communicate knowledge about spatial patterns and processes, geographers use many methods and tools, including mapping. Cartography—the art, science, and technology of making maps—is thus of utmost importance to the study and practice of geography.

The discipline of cartography has great potentials, but also faces many challenges.
The fundamental principles of cartography have changed little over the last few decades. The discipline has moved increasingly toward automation, however. This trend is positive in many ways. Spatial data are now easily captured, retrieved, stored, managed, and manipulated; displayed and visualized in a heart-beat; and analyzed using a plethora of fancy techniques. Maps are now only a mouse-click away. This is great news for trained cartographers, those of us teaching cartography, and students wishing to learn map-making. However, the fact that almost anybody is now in the position to make maps—good, bad, and ugly ones—poses many new challenges to the discipline of cartography. Indeed, it may even have repercussions at social, economic, and political levels well beyond the cartographer's desk and teacher's classroom. Why?—As Monmonier (1991: 2) pointed out, "maps, like speeches and paintings, are authored collections of information and also are subject to distortions arising from ignorance, greed, ideological blindness, or malice". Learning cartography may thus not be as easy as it seems at first.

Learning cartography means three major things in my course.
It means students should acquire the abilities to (1) explain key cartographic concepts, (2) evaluate map quality according to a series of criteria, and (3) create functional and aesthetically pleasing maps. If successful, students acquire these abilities in the order listed. The third learning outcome is the most complex and attainable only given acquisition of the first two learning outcomes. The third learning outcome can also be achieved only if students develop the technical skills necessary to translate theory into practice. So, let's reverse-engineer things and examine what a functional and aesthetically pleasing map is in the first place and what it takes to create one.

A functional and aesthetically pleasing map has to meet many criteria.
A functional map is one that meets its purpose (e.g., to portray population densities in New Mexico in 2009) and that is suited to the needs of its users (e.g., dissemination via print press or digital media), accurate (e.g., presents information without major errors, including misrepresentations), and easy to use (e.g., legend provides unambiguous key to the map body). An aesthetically pleasing map is one that is harmonic (e.g., map elements are composed in a balanced fashion and emphasized according to their relative importance) and "beautiful" in terms of symbols, colors, and typography. But what does it take to make a map that is both functional and aesthetically pleasing?

Creating a functional and aesthetically pleasing map requires a lot.
It requires a clear identification of the map's purpose and, subsequently, a series of informed decisions that help meet that purpose. That is, given a specific map purpose, one has to answer the following major questions: What's the optimal map scale? What's the best map projection? What are the most suitable data? How should the data be classified, simplified, and symbolized?

What's the most appropriate map type? How should the visual elements of a map be arranged from a planar and hierarchical organizational viewpoint so that they are at the right intellectual level in the overall composition? How should features in the map body and elements in the overall map composition be labeled? How, if at all, should color be used in the map? What is necessary to make the map look just right when it is printed or displayed on-screen? What else? The point is: many decisions have to be made to create a functional and aesthetically pleasing map. Making the best possible decisions requires knowledge and comprehension of key cartographic concepts (Learning Outcome #1). Understanding what the best possible decisions are allows one to evaluate the quality of existing maps based on various criteria such as map scale, symbolization, or map composition (Learning Outcome #2). Being able to evaluate the quality of existing maps is a major step toward generating a new functional and aesthetically pleasing map (Learning Outcome #3). Another step is required, however, and this step revolves around the technical skills necessary to translate theory into practice. The big question now is: how do I set students up for success, i.e., to acquire the learning outcomes?

The course integrates theory and practice; the course structure reflects the decision-making process outlined above.

My Cartography course has a lecture and a lab component. Broadly speaking, the lectures are designed to help students comprehend key cartographic concepts and, eventually, evaluate the quality of existing maps. The labs are designed to help students solidify this conceptual understanding and also develop the practical skills necessary to create functional and aesthetically pleasing maps. Making such high-quality maps requires a lot, but "a lot" cannot be taught or learned all at once. So, I teach key issues one at a time, in a sequence that corresponds largely with the decision-making process outlined above. I begin the course with an introduction to the history of cartography, mainly to help students appreciate the possibilities and pitfalls of modern geospatial data, methods, and technologies. I continue with an overview of the map design process so that students can better estimate what it takes to make a high-quality map (i.e., knowledge and skills in all topic areas discussed throughout the rest of the term). What follows next is a step-by-step treatment of the many things that influence whether a map will be a good, bad, and/or ugly map: map scale, map projections, geospatial data, symbolization, classification, map types, typography, map composition, map publishing, and so forth. At the end of the term, the challenge is to re-integrate all of these individual ideas to make a high-quality map. This process can be quite tricky. To help students succeed, I have reserved several weeks at the end of the semester to do nothing but that. How? Students produce maps of their choice and, in teams and with my assistance, evaluate the quality of their own maps given many of the criteria discussed throughout the term. Hopefully, by the time students produce their third personal map, they have succeeded at reassembling the pieces of the big puzzle. Why? Because while Cartography builds on some courses in the curriculum, it lays the foundation for others …

Cartography is an intermediate course in the geography curriculum.

Cartography is a useless endeavor unless the cartographer already has the abilities to: think spatially about people and the environment; discuss who maps what, where, when, and why; and read, analyze, and interpret existing maps. The Cartography course thus builds on lower-division courses in Human, Physical, and Regional Geography as well as Map Use, all of which help students develop these abilities. Conversely, upper-division courses in Geographic Information Systems (GIS) and Remote Sensing (RS) in particular are relatively useless unless students already have the ability to communicate GIS and RS spatial analysis results via maps. The Cartography course thus also lays the foundation for upper-division courses.