THE OHIO STATE UNIVERSITY

Department of Geography

Derby Hall
154 N Oval Mall
Columbus, OH 43210

April 12, 2023

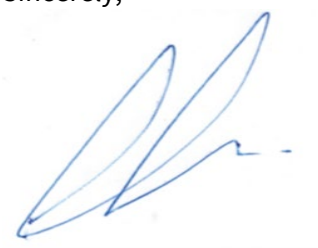
Dear ASCC Members,

I'm writing in my capacity as Chair of the Department of Geography. The purpose of this letter is to write in support of our submission to the ASC Curriculum Committee to consider our proposal to revise the major curricula for our Bachelor of Science in Geographic Information Sciences (GIS).

This proposal package is being submitted with my consent and has gone through the appropriate departmental channels for review before submission. I believe the changes outlined above are prudent for our GIS curricula.

Please find enclosed our documents including, a revision proposal, revised and current major advising sheets, and a curriculum map. If you have any questions, please feel free to contact me.

Sincerely,



Mat Coleman

Professor and Chair, Department of Geography, College of Social and Behavioral Sciences
http://u.osu.edu/coleman.373/

Proposal: Revision to Undergraduate Bachelor of Science in Geographic Information Sciences

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1. General Information

Name of revised major:	Geographic Information Science (unchanged)
Degree to be received:	Bachelor of Science in Geographic Information Science
Proposed implementation date:	Spring 2024
Academic units:	Department of Geography / Social and Behavioral Sciences / ASC

2. Rationale

The Department of Geography launched the Bachelor of Science in Geographic Information Sciences (BS-GIS) in 2009. The program originated from a consensus among our faculty that the then existing undergraduate geography major—despite including GIS courses—was falling short in terms of providing the background and training necessary for students to work as professionals in GIS.[1] Moreover, our faculty agreed at the time that we had the expertise on hand to develop a promising major in GIS. A decade later, we are maintaining a BS-GIS program of more than 100 students and it has become a cornerstone in our department in terms of course offerings and major count. However, important gaps in the curriculum have become apparent over the past ten years. This document outlines those challenges and our plans for revising the program.

2.1. Our GIS curriculum from a disciplinary perspective

The BS-GIS curriculum was originally designed using the GIS&T (Geographic Information Science and Technology) Body of Knowledge (BoK), compiled by the University Consortium of Geographic Information Science (UCGIS).[2] In order to provide a holistic view of the breadth and depth of the theory, methods, and applications of the field, the BoK identifies ten fundamental areas of competence for GIS professionals. These ten areas include: fundamental concepts (FC), programming and development (PD), domain application (DA), knowledge economy (KE), data capture (DC), analytics and modeling (AM), GIST and society (GS), computing platform (CP), data management (DM), and cartography and visualization (CV).

Based on the BoK, the following learning outcomes were identified for the BS-GIS (emphases added here):

1. Students acquire fundamental **concepts** of geographic information sciences.
2. Students achieve proficiency with **methods** of geographic information sciences.
3. Students can **represent** complex technical information orally, visually, or in writing.
4. Students can **apply** geographic information science concepts and methods in experiential and/or research settings.

[1] GIS refers to both Geographic Information Systems and Geographic Information Science. Geographic Information Science concerns the technical implementation of Geographic Information Systems. Whereas Geographic Information Systems refers to the nature of spatial data, i.e., 'what' and 'where' questions, Geographic Information Science refers to 'how' spatial data is collected and analyzed.

[2] http://gistbok.ucgis.org/

The following table shows how the BoK-inspired learning outcomes, categorized by knowledge areas, are covered in our current GIS curriculum. Our assumption at the time we created the degree was that students will achieve proficiency in the four learning outcomes by virtue of encountering them in various pedagogical contexts during their matriculation in the program.

UCGIS GIS&T Body of Knowledge Area	BS-GIS Learning Outcomes	Courses
FC: Fundamental Concepts	1	4103 Introductory Spatial Data Analysis 5200 Cartography and Map Design 5210 Fundamentals of Geographic Information Systems 5225 Geographic Applications of Remote Sensing
KE: Knowledge Economy	4	
CP: Computing Platform	1, 2, 4	5222 GIS Algorithms and Programming 5223 Design and Implementation of GIS 5229 Emerging Topics in GIS (Spatial Data Analytics in R)
PD: Programming and Development	2	5222 GIS Algorithms and Programming 5223 Design and Implementation of GIS 5229 Emerging Topics in GIS (Spatial Data Analytics in R)
DC: Data Capture	1, 2	5200 Cartography and Map Design 5210 Fundamentals of Geographic Information Systems 5225 Geographic Applications of Remote Sensing
DM: Data Management	1, 2	5210 Fundamentals of Geographic Information Systems 5212 Geospatial Databases for GIS
AM: Analytics and Modeling	1, 2	4103 Introductory Spatial Data Analysis 5103 Intermediate Spatial Data Analysis 5225 Geographic Applications of Remote Sensing 5226 Spatial Simulation and Modeling in GIS
CV: Cartography and Visualization	1, 2, 3	5200 Cartography and Map Design 5201 GeoVisualization
DA: Domain Applications	4	
GS: GIS&T and Society	1, 3, 4	

The table suggests some distinct curricular opportunities. Specifically, three important knowledge areas, KE (Knowledge Economy), DA (Domain Applications), and GS (GIS&T and Society) are not sufficiently covered in our existing courses. We stress that this mapping exercise was not done in 2008 when the major was originally proposed, and that a majority of the courses in the above table had been proposed along with the degree and hence had not been taught at that time. The gaps in the curriculum have become apparent more recently, thanks to a careful curricular review undertaken by Professor Ningchuan Xiao, who is the department's lead on GIS pedagogy for both undergraduate and graduate students.

The lack of coverage of these specific knowledge areas reflects two basic gaps in the curriculum.

The first gap, concerning KE and GS, relates to the profession of GIS (or equivalently GIS&T in the context of our curriculum and proposed curricular revision). According to the GIS&T BoK, KE refers to “the growth of the

field, particularly in areas related to the professional realm." A course covering KE-related competencies should include topics such as "the education and training of personnel, labor and management issues, professional standards (like certification and ethics), industry economics and impacts, and overarching professional community issues". In contrast, GS (GIS&T and Society) refers to the "connections and interactions between GIS&T and society range in scale from institutions and business enterprises down to the individual level." A course covering GS should include topics such as privacy issues related to spatial data and technology, decision options regarding ethical issues in geospatial applications, and critiques of GIS.

It is important to note that the KE and GS gap in our curriculum does not mean we do not teach concepts applicable to these knowledge areas. In fact, we do cover topics in KE and GS in some courses in various ways. For example, in GEOG 5223 (Design and implementation of GIS) students typically spend one week discussing professional standards and ethics in GIS. Students encounter similar material in GEOG 5200 (Cartography and Map Design). However, what we are currently teaching is lagging with respect to a) a dynamic professional environment marked by recent, and multiplying, GIS-related ethics and professionalism controversies, as well as b) a social context in which data and computing is having an increasingly deep impact on individuals and groups, and as such is subject to significant scrutiny and debate. As a result of these contexts, we see a need to improve on our delivery of KE and GS knowledge areas in our curriculum.

The second gap in our curriculum is related to our thin coverage of DA (Domain Applications)-related material. DA includes understanding GIS in various public health, retail business, marketing, environmental science and management settings, among others. Courses in our current curriculum cover some of these applications. For example, in our current curriculum students can use one 5000-level topical course in Geography toward their degree, and many students choose GEOG 5300 (Geography of Transportation) for this purpose. Students can also take various urban studies and environment and society courses as part of their degree progression. We also note that it is reasonable that we restrict DA-related training in order to keep the degree manageable from the standpoint of credit hours and student completion. However, we acknowledge that our curriculum can and should provide more DA-related training. Moreover, our former students repeatedly comment that they would have appreciated more application courses.

2.2. Our curriculum from a departmental perspective

The four learning outcomes listed above are specific for the undergraduate BS-GIS program. We use them to communicate with students about what is required for a professional career in GIS and to assess how students are performing in the program. As shown in the previous table, these outcomes intentionally overlap with the USGIS knowledge areas, and are core to our student's continued success in our program.

The Department of Geography went through a broad undergraduate curriculum mapping process in 2019 and 2020. As a result of this process the faculty agreed upon a set of department-wide program goals, outcomes, and proficiencies which are generalizable across our Atmospheric Sciences, Physical Geography, Human Geography, and GIS curricula. The table in Appendix A summarizes the mapping result for our BS-GIS courses. The detailed curriculum map is included in Appendix B, where the grouped columns called GIS and GIS 2 are for courses in the current and the proposed revised curriculums, respectively.

As a result of this exercise, it became clear to the GIS faculty that proficiencies under Goals D (critical thinking and ethical engagement) and E (professional development) are insufficiently covered in the BS-GIS curriculum. Neither our required nor elective courses are doing this work. This finding mirrors the discussion in the previous section about the curriculum gap in KE and GS.

3. Proposed Curriculum Revision

We are proposing three core revisions to our existing BS-GIS curriculum to address the curricular gaps discussed in the previous section:

- **A newly refocused 'scaffolding' of required and elective courses.** Our previous curriculum required students to complete eight required courses and three electives—using very broad groupings of courses (see Appendix C). Our new curriculum will require the same amount of coursework but will focus coursework on smaller and more intentional groupings of courses: five required core courses, three intermediate courses (from a set of seven courses), and three electives from a comprehensive list of courses newly available to our GIS majors.
  - The new designation of 'core' courses that build the foundation needed by every GIS major to succeed in their career and therefore are required.
  - The new designation of 'intermediate' courses is intended to provide students the opportunity to dive deeper into GIS-specific materials. Students can intentionally choose intermediate courses to build a profile that highlights either the depth or breadth (or both if combined with the electives) of their skillset. We will provide some example profiles below (page 6) when we discuss these courses.
  - The newly proposed elective coursework is focused on substantive application areas (data analytics, urban studies, and sustainability), as per the UCGIS GIS&T BoK. While the BoK does not necessarily exhaust all the possible domains where GIS can be applied,[3] the three areas of our elective list—data analytics, urban studies, and sustainability—correspond broadly with the BoK knowledge areas of geocomputation or computational geography, urban related applications, and management or resources related applications, respectively. While we are not requiring students to choose electives only from one area of applications, by making these areas legible in the advising sheet will help students understand the scope of the disciplines and help our advising team when they communicate with the students.

- **GE Embedded Literacies.** Two courses in the current curriculum meet the GE embedded literacies of Technology (GEOG 5210) and Data Analysis (GEOG 4103). These two courses and their corresponding embedded literacies are included in the required core courses of the revised curriculum. The newly added required core course, GEOG 5101, will meet the Embedded Literacy of Advanced Writing as students in this course will write three long essays and a comprehensive summary from an interview with a GIS professional. In these writing assignments, students should demonstrate their inquiry and critical thinking skills in writing about professionalism and ethics in the field of GIS and how their knowledge about GIS can be applied to new problems. For this reason, GEOG 3597.03, which was used to meet the Embedded Literacy of Advanced Writing, is now removed from the curriculum of the major.

- **A new course, GEOG 5101 (GIST Professionalism and Ethics).** GEOG 5101 will directly address KE and GS knowledges areas, as outlined in the UCGIS GIS&T BoK, as well as our department's specific proficiencies D (critical thinking and ethical engagement) and E (professional development). This course is already approved and is ready to be offered in Spring 2024.

- **We are removing GEOG 5226 (Spatial Simulation and Modeling in GIS) from the undergraduate curriculum.** This course—currently an elective—satisfies the analytics and modeling knowledge area. This knowledge area is one of the strongest in our program and will be more than adequately satisfied by the remaining three analytics and modeling courses, which are required in our revised curriculum: GEOG 4103 (Introductory Spatial Data Analysis), GEOG 5103 (Intermediate Spatial Data Analysis), and GEOG 5225 (Geographic Applications of Remote Sensing). Removing GEOG 5226 from the undergraduate curriculum allows us to focus our undergraduate teaching resources on our expanded list

[3] http://gistbok.ucgis.org/knowledge-area/domain-applications

of required 'core' and 'intermediate' courses. GEOG 5226 will be changed to a 6000-level class and added to our new professional master's program, which has been formally approved.

The table in Appendix C summarizes the differences between the two curricula. We discuss these changes at length in the next section. The current advising sheet can be found in Appendix D. We also attached the revised advising sheet in Appendix E where the Embedded Literacies are marked.

4. Description of the Revised Curriculum

The total number of credit hours for the revised major remains 33 (or 11 courses), as required in the current curriculum. All our courses are currently three credit hours.

The revised BS-GIS curriculum consists of three categories of courses. Students must complete five required core courses, three intermediate GIS courses (from a list of seven courses), and three elective courses. Electives are grouped into three areas: spatial data analytics, focused on programming and data analysis; urban studies, focused on urban political economy and infrastructure; and sustainability, focused on environment and society. Students will be encouraged to focus coursework and interests within these three application areas to connect skillset to professional development and career applications. However, students are permitted to complete their major elective requirement by selecting any three courses (9 credits) within the entire course offerings for GIS major electives.

Core courses (*15 hours*)

The core courses cover the fundamental concepts of GIS—spatial data analysis (GEOG 4103), professionalism and society (GEOG 5101), map making (GEOG 5200), fundamental GIS concepts and applications (GEOG 5210), and remote sensing (GEOG 5225).

- *GEOG 4103 Introductory Spatial Data Analysis*
  An introduction to spatial data analysis in geography: the fundamental statistical and spatial analysis methods used in quantitative geographic research.
- *GEOG 5101 GIST Professionalism and Ethics*
  For a practitioner in this broad field of geographical information science and technology (GIST), what does "being professional" mean? Is doing your job competently enough to be at your job? What constitutes professional competence in this profession? This course will help students address these questions and find their moral compass in a constantly changing profession.
- *GEOG 5200 Cartography and Map Design*
  A study of the cartographic techniques of map compilation and design including generalization, symbolization, reproduction, and GIS-based mapping with an emphasis on thematic mapping.
- *GEOG 5210 Fundamentals of GIS*
  Basic principles of geographic and land information systems and their use in spatial analysis and information management.
- *GEOG 5225 Geographic Applications of Remote Sensing*
  Introduction to the fundamental principles, methods, and geographic applications of remote sensing.

Intermediate courses (*choose 3 courses, 9 hours*)

These courses extend what students have learned in the core courses. GEOG 5103 extends what is covered in 4103 with multivariate and spatial regression models. GEOG 5201 leads students to more sophisticated visualization methods such as interactive maps. GEOG 5212 extends the database aspect of GIS introduced in GEOG 5210. GEOG 5222 and 5223, together in a sequence, develop students' programming and software

development skills. GEOG 5223 also introduces students to project management concepts and practices in a software development project context. GEOG 5229 covers new developments in the world of GIS and spatial analysis. In addition to these courses, we also include Internship in Geography (GEOG 4191) as an intermediate offering. Students taking this course must have a GIS-related internship placement where their in-the-workplace experience fulfills the learning goals of the program.

- *GEOG 4191 Internship in Geography*
  An opportunity for practical experience and on-the-job learning in a Geography-related workplace.
- *GEOG 5103 Intermediate Spatial Data Analysis*
  An intermediate class in spatial data analysis for geography. This course focuses on multivariate model building and evaluation, with a special emphasis on multiple regression models commonly used by geographers: spatial regression, conditional autoregressive, and geographically weighted regression.
- *GEOG 5201 GeoVisualization*
  Examination of issues, techniques and applications of analytic cartography, interactive maps, and scientific visualization for exploring geographic data.
- *GEOG 5212 Geospatial Databases for GIS*
  Focuses on designing, implementing, querying and managing spatial databases or persistent data stores where most entities have footprints in geographic space and time. This is critical for designing and implementing GIS for projects and organizations. It is also crucial for moving beyond GIS to the bigger world of geographic information services.
- *GEOG 5222 GIS Algorithms and Programming*
  The theory and algorithms underpinning today's GIS technology and the development of custom GIS applications using the Python programming language.
- *GEOG 5223 GIS Design and Implementation*
  Practice-oriented development, design, implementation and evaluation of spatial databases, with an emphasis on local problems.
- *GEOG 5229 Emerging Topics in GIS*
  Examination of major recent developments in the theories, technologies, and/or applications of geographical information science.

These intermediate courses are grouped to help students build their professional profiles. They can choose to broaden their training by choosing courses in different areas (e.g., GEOG 4191, 5201, and 5212). They can also intentionally "stack" courses to demonstrate the depth of their training. For example, students choosing GEOG 5212, 5222, and 5223 will demonstrate very strong training in programming and development, while those who take GEOG 5103, 5222, and 5229 will be well equipped to go on a career as a spatial data scientist.

Electives (*choose 3 courses, 9 hours*)

Our newly revised electives are grouped into three broad application areas. The first area focuses almost exclusively on methods and technologies for students with career aspirations in data science. The two remaining application areas build on the strength of human geography courses to give GIS majors competency in urban studies and sustainability. The urban studies and sustainability knowledge areas will also help build linkages between our GIS and human geography student cohorts.

Students will be encouraged to focus coursework and interests within these three application areas to connect skillset to professional development and career applications. However, students are permitted to complete their major elective requirement by selecting any three courses (9 credits) within the entire course offerings for GIS major electives. While students can use courses from any areas to count toward their major, our groupings will be communicated to students who are interested in building up their profile with different career focuses and enable students to highlight the electives on their resume for job applications.

Spatial Data Analytics – nine hours, choose at least one intermediate course in GIS and up to two from the following to focus

- CSE 2122 Data Structures Using C++
  OR
  CSE 2123 Data Structures Using Java
- CSE 2221 Software I: Software Components
- CSE 2231 Software II: Software and Development
- CSE 3241 Introduction to Database Systems
- CSE 5242 Advanced Database Management Systems
- CRPLAN 5320 Introduction to Data Analytics for Transportation Planners
- PUBAFRS 4040 Public Sector Data Sciences and Management

Urban Studies – nine hours, choose three courses to focus

- GEOG 5300 Geography of Transportation
- GEOG 5301 Sustainable Transportation
- GEOG 5501 Urban Spaces in the Global Economy
- GEOG 5502 Data Justice and the Right to the Smart City
- GEOG 5503 Urban China: Space, Place, and Urban Transformation

Sustainability – nine hours, choose three courses to focus

- GEOG 3597.03 Environmental Citizenship
- GEOG 3702 Life & Death Geographies: Global Population Dynamics
- GEOG 3800 Geographic Perspectives on Environment & Society
- GEOG 5301 Sustainable Transportation
- GEOG 5402 Land Use Geography
- GEOG 5700 Geography of Development
- GEOG 5802 Globalization & Environment
- GEOG 5803 Sustainable Energy Geographies

5. Assessment plan

In the past, only a few GIS classes—GEOG 5210, 5222, and 5225—were selected for program assessment. These assessments were conducted using embedded questions and pre/post-test surveys that were given at the beginning and end of a semester, respectively. In Autumn 2022, the GIS faculty met to discuss a more comprehensive long-term assessment plan for the program. This plan includes a schedule of when the courses will be used for assessment from Spring 2023 to Spring 2026, as shown in the following table, where each initial indicates the faculty member who will conduct the assessment in a semester. We intend to use the four courses in SP 23 and AU 23 as a trial run of assessment so that the GIS faculty can be familiar with the assessment process.

Courses	**Semester and year to be assessed**						
	SP 23	AU 23	SP 24	AU 24	SP 25	AU 25	SP 26
GEOG 4103							CS
GEOG 5101			NX				
GEOG 5103					HL		

GEOG 5200	TP	TP					
GEOG 5201	CS				CS		
GEOG 5210			TP				
GEOG 5212			CS				
GEOG 5222							NX
GEOG 5223	NX					NX	
GEOG 5225				DL			
GEOG 5229						HL	

In Spring 2023, instructors of GEOG 5200 and GEOG 5201 plan to use the pre/post-test surveys as this approach is relatively more straightforward to be adopted for the two instructors who are recently hired in 2022. In the meantime, GEOG 5223 will use a rubric to assess the program learning outcomes. GEOG 5223 is typically the last course most of our GIS students will take in the program and students will conduct an intensive group project, which includes the development of a tool for spatial data handling, presentations, and multiple documents throughout the semester. The rubric (see the table below) is developed based on the final project, where each program learning outcome is evaluated based on the traits listed and is given one of three ratings of Does not meet, Meets, or Exceeds.

Learning outcome	**Does not meet** *The student shows at least one trait listed below*	**Meets** *The student shows at least one trait listed below and is free of any trait in the "Does not meet" column*	**Exceeds** *The student shows not only all the traits in the Meets column, but also demonstrates the ability to go above and beyond what is taught in the classes in showing at least one trait listed below*
1. Students acquire fundamental concepts of geographic information sciences.	Shows minimal understanding of the concepts in GIS and applications. Has minimal knowledge about geospatial data. Is unfamiliar with the use of GIS. Has limited knowledge about the development of GIS.	Demonstrates a clear understanding of GIS concepts. Is knowledgeable about different development methods and platforms. Is knowledgeable about many of the different kinds of spatial data.	Understands the importance of clean code in a team environment. Take ownership of work. Can apply concepts not focused in this class in the project.
2. Students achieve proficiency with methods of geographic information sciences.	Cannot write effective computer code. Has limited understanding of how GIS development projects work.	Shows proficiency in writing code to handle spatial data. Understands how GIS development projects work.	Demonstrates effective management skills in a team GIS development project. Can write code to implement user-friendly and intuitive user interfaces.

		Understands and practices different roles in a project setting. Can write interactive tools.	
3. Students can represent complex technical information orally, visually, or in writing.	Includes little supporting details and/or examples in writing. Writing is murky and poorly edited. Maps, illustrations, and tables are not accurate OR do not add to the reader's understanding of the topic. Makes unprofessional maps. Has limited understanding of how to choose appropriate visualization/mapping techniques for different data.	Includes some supporting details and/or examples in writing. Writing is clear and well edited. Maps, illustrations, and tables are somewhat neat/accurate and sometimes add to the reader's understanding of the topic. Makes professional maps.	Includes exceptional supporting details and/or examples in writing. Writing is exceptionally clear and well edited. Maps, illustrations, and tables are neat, accurate, and add to the reader's understanding of the topic. Makes professional maps that clearly stand out among others. Can develop interactive maps.
4. Students can apply geographic information science concepts and methods in experiential and/or research settings.	Cannot identify the theories related to real world applications. Cannot identify a GIS solution to real world applications.	Shows clear understanding of how GIS tools and data can be used in an application. Able to make connections between spatial theory and applications. Able to design a GIS solution to address real world problems.	Provides rich details about context of real-world GIS applications. Articulates the pros and cons of the theories related to real world applications. Able to communicate with the users, stakeholders and the general public regarding the use of GIS for real world applications.

At the end of Autumn 2023, the GIS faculty will meet again to evaluate the pros and cons of different assessment approaches and to develop best practice methods to prepare for the assessment of the revised major. We also decided to meet at least once a year for program assessment. These meetings will have four purposes. First, the GIS faculty will learn from each other about the pros and cons of different assessment approaches. Second, we will write a summary of overall assessment of the program and submit it to the department leadership. Third, we will fine tune the assessment schedule if necessary. Finally, these meetings will also help us understand potential problems in our curriculum and identify strategies to improve our program.

6. Relationship to Other Programs / Benchmarking

The department currently has two more GIS related undergraduate programs: Bachelor of Science in Geography with a concentration in Spatial Analysis and the Geographic Information Science Minor. The revision of the BS-GIS major will not have significant impact on those two programs. We are submitting the revision proposal for the minor together with this proposal. We will not make any changes to Bachelor of Science in Geography at this point.

7. Implementation Plan

The revised major curriculum will be implemented in Spring 2024. All students declaring BS-GIS as their major in or after Spring 2024 will use this new curriculum.

Existing BS-GIS major students prior to Spring 2024 will follow the current BS-GIS curriculum for their degree. For this 'grandfathered' cohort, the key challenge will be the removal of GEOG 5226 from our undergraduate curriculum. Current students will be allowed to use GEOG 5101, or another suitable GIS course as a substitute (in cases where departmental course offering of GEOG 5101 impacts student progression toward degree completion and graduation. Substitutions for GEOG 5226 will be determined by the Undergraduate Studies Chair and our academic advising staff on a case-by-case basis.

GEOG 5226 is currently an elective, offered in the autumn semester only. Since we first started offering the class in AU2015, the course has enrolled an average of 44.8 students per offering. However, enrollment in the course has fallen in the two semesters after the resumption of post-pandemic teaching. Using enrollment data from the past two years, we expect the removal of GEOG 5226 from the curriculum to result in 35 substitutions annually until the current cohort of students is graduated.

Autumn semester	Enrollment	Cap	Fill rate
2015	50	50	100%
2016	50	50	100%
2017	50	50	100%
2018	47	50	94%
2019	47	48	98%
2020	46	48	96%
2021	38	45	84%
2022	30	50	60%
Average	**44.8**		

Sample 4-year timelines for BS-GIS

Here we use an example to show how a student who starts to take BS-GIS major courses (bold) in the second year can complete the program in 4 years. Courses labeled as 'open electives' are student choices.

	Autumn Semester		Spring Semester	
Year 1	ASC: College Survey (ASC 1100.XX)	1	GE: Launch Seminar (ACADAFF 1201)	1
	GE: Writing and Information Literacy	3	GE: Math / Data Analytics: (MATH 1151)	5
	GE: Social & Behavioral Sciences	3	GE: Historical & Cultural Studies	3
	GE: Race, Ethnicity and Gender Diversity	3	GE: Foundations: Natural Sciences (w/lab)	4

	GE: Literary, Visual and Performing Arts	3	GE: Second Theme (1) 3	3
	Total hours	***13***	***Total hours***	***16 (29)***
Year 2 (Major)	GE: Citizenship for a Diverse & Just World	3	GE: Citizenship for a Diverse & Just World	3
	ASC: Language Requirement (X 1101)	4	GE: Second Theme (2)	3
	Major Core Course (1) GEOG 5101	***3***	ASC: Language Requirement (X 1102)	4
	Major Core Course (2) GEOG 5210	***3***	***Major Core Course (3) GEOG 4103***	***3***
	Open Elective (1)	3	***Major Core Course (4) GEOG 5200***	***3***
	Total hours	***16 (45)***	***Total hours***	***16 (61)***
Year 3 (Major)	ASC: Language Requirement (X 1103)	4	***Major Intermediate Course (2)***	***3***
	Major Core Course (5) GEOG 5225	***3***	***Major Elective (1)***	***3***
	Major Intermediate Course (1)	***3***	Open Elective (4)	3
	Open Elective (2)	3	Open Elective (5)	3
	Open Elective (3)	3	Open Elective (6)	3
	Total hours	***16 (77)***	***Total hours***	***15 (92)***
Year 4 (Major)	***Major Intermediate Course (3)***	***3***	***Major Elective (3)***	***3***
	Major Elective (2)	***3***	Open Elective (10)	3
	Open Elective (7)	3	Open Elective (11)	3
	Open Elective (8)	3	Open Elective (12)	3
	Open Elective (9)	3	Open Elective (13)	3
	GE: ACADAFF 4001 GE Reflection	1		
	Total hours	***16 (108)***	***Total hours***	***15 (123)***

The following schedule is an example for students who declare their major in BS-GIS late in their 3rd year. By moving the major requirements to the last two years, we believe students can finish the program in two years if other requirements are satisfied. The following is such an example that shows a student starting the BS-GIS major in year 3, hypothetically switching from another major where the open electives are courses from that major.

	Autumn Semester		**Spring Semester**	
Year 1	ASC: College Survey (ASC 1100.XX)	1	GE: Launch Seminar (ACADAFF 1201)	1
	GE: Writing and Information Literacy	3	GE: Math / Data Analytics: (MATH 1151)	5
	GE: Social & Behavioral Sciences	3	GE: Historical & Cultural Studies	3
	GE: Race, Ethnicity and Gender Diversity	3	GE: Foundations: Natural Sciences (w/lab)	4
	GE: Literary, Visual and Performing Arts	3	GE: Second Theme (1)	3
	Total hours	***13***	***Total hours***	***16 (29)***
Year 2	GE: Citizenship for a Diverse & Just World	3	GE: Citizenship for a Diverse & Just World	3
	ASC: Language Requirement (X 1101)	4	GE: Second Theme (2)	3
	Open Elective (1)	3	ASC: Language Requirement (X 1102)	4
	Open Elective (2)	3	Open Elective (4)	3
	Open Elective (3)	3	Open Elective (5)	3
	Total hours	***16 (45)***	***Total hours***	***16 (61)***
Year 3 (Major)	ASC: Language Requirement (X 1103)	4	***Major Core Course (4) GEOG 5225***	***3***
	Major Core Course (1) GEOG 5101	***3***	***Major Core Course (5) GEOG 5200***	***3***
	Major Core Course (2) GEOG 5210	***3***	***Major Intermediate Course (1)***	***3***
	Major Core Course (3) GEOG 4103	***3***	Open Elective (7)	3
	Open Elective (6)	3	Open Elective (8)	3
	Total hours	***16 (77)***	***Total hours***	***15 (92)***
Year 4 (Major)	***Major Intermediate Course (2)***	***3***	***Major Intermediate Course (3)***	***3***
	Major Elective (1)	***3***	***Major Elective (3)***	3
	Major Elective (2)	***3***	Open Elective (11)	3
	GE: ACADAFF 4001 GE Reflection	1	Open Elective (12)	3
	Open Elective (9)	3	Open Elective (13)	3
	Open Elective (10)	3		
	Total hours	***16 (108)***	***Total hours***	***15 (123)***

Breakdown of credit hours for the above two examples:

General education requirements: 38
College of Arts and Sciences requirements (language and ASC 1100 Survey): 13
Major requirements: 33
Other electives: 39

We note the 39 hours from other elective will help students to work on required courses from a second major, minor, or certificate program. This will also provide flexibility for students interested in pursuing additional academic opportunities of education abroad, internship, or research for credit.

Appendix A. Summary of Coverage of Department-wise Proficiencies

The follow table summarizes and compares the coverage of the department-wise proficiencies by the courses of the current GIS curriculum (Required and Electives) and the revised GIS curriculum being proposed. Numbers are the of times each proficiency is covered by the courses labeled in each column. The actual proficiency descriptions can be found in the attached spreadsheet. Electives for the revised curriculum are not listed, but can be found in the attached spreadsheet. The original data can be found in Appendix B.

Learning Outcomes	Current		Revised	
	Required	Electives	Core	Intermediate
Goal A: Human, Environmental, and Spatial Concepts Students understand various conceptual approaches and their context to interpret patterns, processes and their relation.				
1. Conceptualize human, environmental, or spatial problems				
a. Describe the spatial and historical context of a problem	2	0	1	1
b. Identify the 'ecological fallacy' (the inappropriate homogenization or aggregation of differentiated phenomena within a unit of analysis, using scale as an analytical unit)	3	2	2	2
c. Examine dynamics within a place's or system's boundaries, and implications for real-world problems	0	**1**	0	0
d. Examine dynamics that connect places or systems across space, and implications for real-world problems	0	**1**	0	0
e. Evaluate processes that operate at different scales and their effects	0	2	0	1
2. Critically evaluate different approaches to describe, explain, or predict real-world experience				
a. Describe the strengths and weaknesses of various approaches for their utility in interpreting real-world experience	8	2	5	5
b. Explain the contexts in which various approaches were developed	2	0	1	2
c. Critically evaluate various approaches in their field of study	5	1	3	4
3. Appraise the relation between concepts and real-world experience				
a. Interpret patterns	3	3	3	2
b. Critique how knowledges in their fields are used in developing solutions to real-world problems	1	0	1	1
c. Relate research findings to debates about different approaches to research	**0**	**0**	1	0
d. Relate patterns to processes to assess causal relations	0	2	1	1
Goal B: Research Strategies, Methods and Data Students are able to apply appropriate methods and data, to transform data into actionable knowledges to support ethical scholarship and decision making.				
1. Gather information regarding data and their context to draw conclusions				
a. Identify relevant data sources and their quality	3	0	2	1
b. Collect data from relevant sources	2	0	1	1
c. Design feasible data-collection procedures	2	0	2	0
d. Explain how context shapes conclusions drawn from data	**0**	**0**	1	0
2. Evaluate research strategies and methods to engage problems				
a. Identify available research strategies and methods	2	1	1	3
b. Explain how strategies and methods may be used constructively and destructively in real-world applications	1	0	1	1
c. Provide empirical examples of constructive and destructive applications of methods	**0**	**0**	1	0
d. Assess the strengths and limitations of available research strategies and methods	2	1	1	3
3. Apply strategies and methods				

a. Visualize patterns through mapping, graphing, or using GIS techniques	8	3	4	6
b. Identify sources of uncertainty or partial knowledges	3	1	3	2
c. Analyze how errors propagate through data processing	0	0	0	0
d. Examine the impacts of sources of uncertainty or partial knowledges on the reliability of data	**0**	**0**	1	0
e. Apply interactive and dynamic visualization techniques	4	1	1	3
f. Analyze patterns using appropriate methods	5	2	3	3
g. Apply strategies to mitigate or constructively engage the effects of uncertainty or partial knowledges	0	1	1	1
h. Interpret data and results using appropriate methods	6	3	3	5
Goal C: Communication and Engagement The successful student will be able to share and receive knowledge by engaging with diverse audiences, participants, and stakeholders.				
1. Disseminate knowledges				
a. Identify modes by which knowledges can be disseminated	2	0	0	2
b. Recognize that different audiences will have different degrees of familiarity with subject being presented	**0**	**0**	1	0
c. Summarize an author's argument in their own words	**0**	**0**	1	0
d. Deliver oral presentations	0	1	1	1
e. Adjust the language and technical level of oral or written presentation relative to different audiences	0	1	1	1
f. Evaluate the standard modes of dissemination of knowledges for their strengths and weaknesses in a given context	0	0	0	0
g. Use visual methods to enhance oral or written presentation	2	2	0	4
h. Construct other output or products using diverse media, art, activism, or other strategies to convey messages from academic research	0	0	0	0
i. Synthesize material from several sources	0	0	0	0
j. Generate a document that develops an argument drawing from multiple sources	0	0	0	0
2. Collaborate in learning and research				
a. Demonstrate responsiveness to others	0	0	0	0
b. Demonstrate ability to work with a division of labor in a collaborative project	0	0	0	0
c. Demonstrate ability to work with people of varying cultures, backgrounds, abilities, ideas, ideals, and status	0	0	0	0
d. Employ teamwork to achieve results	0	1	0	1
Goal D: Critical Thinking and Ethical Engagement The successful student is intellectually curious, interested in scrutinizing their assumptions, and is aware of the ethical dimensions of their professional activity regarding real-world problems to work towards justice.				
1. Critically engage real-world problems				
a. Identify multiple sides of a problem	2	0	1	2
b. Explain multiple sides of a problem	2	0	1	2
c. Explain the real-world consequences of different positions regarding a problem	**0**	**0**	1	0
d. Develop a position based on an understanding of multiple sides of a problem	**0**	**0**	1	0
e. Identify linkages among apparently discrete problems	1	0	1	1
2. Appraise ethical issues in research				
a. Explain how strategies and methods may be used constructively and destructively in real-world applications	1	0	1	1
b. Perceive that everyone, including researchers, implicitly have biases and partial knowledges that can have negative effects on subjects under study	1	0	1	1

c. Perceive that subjects under study and those encountered in the field, their values, and their privacy require respect	**0**	**0**	1	0
d. Analyze their positionality regarding, for example, class, race/ethnicity, gender, age, citizenship, occupation, and the like relative those under study or encountered in the field	**0**	**0**	1	0
e. Integrate ethical considerations into formulation of questions and applications of their knowledges	1	0	1	1
Goal E: Professional Development The successful student understands how to make use of the skills and knowledges developed in their undergraduate program towards securing a job and pursuing a career.				
1. Make use of their values to guide their careers				
a. Identify their value systems relative to career opportunities	**0**	**0**	1	0
b. Describe tensions between their ideals and career realities	**0**	1	1	1
c. Appraise the variety of options and trade-offs in career paths relative to their value systems	**0**	**0**	1	0
2. Deploy their skills relative to a changing job market				
a. Identify the range of their skills relative to a variety of career paths	**0**	**0**	1	0
b. Identify the strengths and limitations of their range of skills relative to various professional opportunities	**0**	**0**	1	0
c. Demonstrate the ability to learn new skills	0	1	1	1
3. Creatively use skills to solve problems beyond those encountered in formal training				
a. Apply knowledge from formal training to examine a problem	1	2	1	3
b. Integrate diverse skills from formal training	1	0	1	1
c. Integrate knowledges from formal training with those acquired independently	1	0	1	1

Appendix B. Curriculum Map

Levels indicated for proficiencies:

B: beginning
I: intermediate
A: advanced

Course colors:
green: courses taught by the same person
blue: courses among which students choose

Codes for mapping proficiencies to your courses:

y: yes, covered and evaluated

c: covered but not currently evaluated OR *could be* covered and evaluated

blank: not covered; no intention to cover [just leave the cell blank].

	GIS																	GIS 2 (to be proposed)																																			
	GEOG 4103	GEOG 5200	GEOG 5201	GEOG 5210	GEOG 5212	GEOG 5222	GEOG 5223	GEOG 5225	GEOG 5225	Required	GEOG 4191	GEOG 5103	GEOG 5226	GEOG 5229	GIS Electives		GEOG 4103	GEOG 5200	GEOG 5210	GEOG 5225	GEOG 5225	GEOG 5101	Core		GEOG 4191	GEOG 5103	GEOG 5201	GEOG 5212	GEOG 5222	GEOG 5223	GEOG 5229	Intermediate			GEOG 5501	GEOG 5502	GEOG 5503	GEOG 5300	GEOG 5301		Urban		GEOG 3597.03	GEOG 3702	GEOG 3800	GEOG 5402	GEOG 5700	GEOG 5802	GEOG 5803		Sustainability
Instructor *We no longer use 'm'.*	DL	EC	YS	EC	EC	NX	NX	YS	DL	"y"	NE	ER	YS	YQ	"y"	Total "y"	DL	EC	EC	YS	DL		"y"		NE	ER	YS	EC	NX	NX	YQ	"y"	Total "y"		MD	NE	MW	HL	HM	Total "y"	"y"		JW	ER	BKM	DM	JW	MD	YQ	"y"	Total "y"
Goal A: Human, Environmental, and Spatial Concepts **Students understand various conceptual approaches and their context to interpret patterns, processes and their relation.**																																																		
1. Conceptualize human, environmental, or spatial problems																																																		
a. Describe the spatial and historical context of a problem (B)	y	c	c	c		y	c	c	y	2			c	c	0	2	y	c	c	c	y		1				c		y	c	c	1	2		y	y	y	y	y	5	7		y	y	y	y	y	y	y	7	9
b. Identify the 'ecological fallacy' (the inappropriate homogenization or aggregation of differentiated phenomena within a unit of analysis, using scale as an analytical unit) (B)	y			c		y	c	y	y	3		y	y		2	5	y		c	y	y		2			y			y	c		2	4		y	y				2	6				c	c		y		1	5
c. Examine dynamics within a place's or system's boundaries, and implications for real-world problems (I)	c				c			y	c	0			y	c	1	1	c			y	c		0					c			c	0	0		y	y	y		y	4	4		y	y	y	y	y	y	y	7	7
d. Examine dynamics that connect places or systems across space, and implications for real-world problems (I)					c			y	c	0			y	c	1	1				y	c		0					c			c	0	0		y	y	y	y	y	5	5		y	y	y	y	y	y	y	7	7
e. Evaluate processes that operate at different scales and their effects (A)	c							c	c	0		y	y	c	2	2	c			c	c		0			y					c	1	1		y	y	y	y	y	5	6		y	c	y	y	y	y	c	5	6
2. Critically evaluate different approaches to describe, explain, or predict real-world experience																																																		
a. Describe the strengths and weaknesses of various approaches for their utility in interpreting real-world experience (B, I)	y	y	y	y	y	y	y	y	y	8		y	y	c	2	10	y	y	y	y	y	y	5			y	y	y	y	y	c	5	9		y	y	y	y		3	12		y	y	y	y	y	y		6	15
b. Explain the contexts in which various approaches were developed (A)	c	c	c		c	y	y	c	c	2			c	c	0	2	c	c		c	c	y	1				c	c	y	y	c	2	2		y	y	c	y		3	5		c		y		c	y		2	4
c. Critically evaluate various approaches in their field of study (A)	c	y	y		c	y	y	y	y	5		y	c		1	6	c	y		y	y	y	3			y	y	c	y	y		4	6		y	y	y	c		3	9		y		y		y	y		4	10
3. Appraise the relation between concepts and real-world experience															0																																		
a. Interpret patterns (B)	y	c		y		c		y	y	3		y	y	y	3	6	y	c	y	y	y		3			y			c		y	2	4		y	y	y	y		4	8		c		y	y	c	y	y	4	8
b. Critique how knowledges in their fields are used in developing solutions to real-world problems (I)	c	c	y	c				y	c	1		c	c	c	0	1	c	c	c	y	c	y	1			c	y				c	1	2		y	y		y		3	5		c	c	y		y	y	y	4	6
c. Relate research findings to debates about different approaches to research (A)						c		c	c	0			c	c	0	0				c	c	y	1						c		c	0	1		y	y	y		c	3	4				y		c	y		2	3
d. Relate patterns to processes to assess causal relations (A)	c								c	0		y	y	c	2	2	c				c	y	1			y					c	1	2		y	y	y	c		3	5		c	c			y	y	c	2	4
Goal B: Research Strategies, Methods and Data **Students are able to apply appropriate methods and data, to transform data into actionable knowledges to support ethical scholarship and decision making.**																																																		
1. Gather information regarding data and their context to draw conclusions																																																		
a. Identify relevant data sources and their quality (B)	y	c	y	c		c	c	y	y	3				c	0	3	y	c	c	y	y		2				y		c	c	c	1	3				y	c		1	4		c	c		c	y		c	1	4
b. Collect data from relevant sources (I)	c	c	y	c		c	c	y	y	2				c	0	2	c	c	c	y	y		1				y		c	c	c	1	2				y			1	3			c			y		c	1	3
c. Design feasible data-collection procedures (I)	y							y	y	2				c	0	2	y			y	y		2								c	0	2				y	c		1	3						c		y	1	3
d. Explain how context shapes conclusions drawn from data (A)		c						c		0				c	0	0		c		c		y	1								c	0	1			y	c			1	2		c				c		y	1	2
2. Evaluate research strategies and methods to engage problems																																																		
a. Identify available research strategies and methods (B)						y	y	c		2		y	c	c	1	3				c		y	1			y			y	y	c	3	3			y	y	y		3	6		c			y	c		c	1	4
b. Explain how strategies and methods may be used constructively and destructively in real-world applications (B, I)						c	y	c		1		c		c	0	1				c		y	1			c			c	y	c	1	1			y	c	y		2	3		c			y	c		c	1	2
c. Provide empirical examples of constructive and destructive applications of methods (I)							c	c		0		c			0	0				c		y	1			c				c		0	1			y	c	c		1	2						c		c	0	1
d. Assess the strengths and limitations of available research strategies and methods (I, A)						y	y	c		2		y	c		1	3				c		y	1			y			y	y		3	3			y	c	c		1	4		c				c		c	0	3
3. Apply strategies and methods																																																		
a. Visualize patterns through mapping, graphing, or using GIS techniques (B)	y	y	y	y	y	y	y	y	y	8		y	y	y	3	11	y	y	y	y	y		4			y	y	y	y	y	y	6	8					y		1	9			c					y	1	9
b. Identify sources of uncertainty or partial knowledges (B, I)	y	c	y	y		c		c	y	3		y			1	4	y	c	y	c	y	y	3			y	y		c			2	5					c		0	5		c				c			0	5
c. Analyze how errors propagate through data processing (I)	c		c						y	0		c			0	0	c				y		0			c	c					0	0					c		0	0									0	0
d. Examine the impacts of sources of uncertainty or partial knowledges on the reliability of data (I)	c	c	c					c	c	0		c			0	0	c	c		c	c	y	1			c	c					0	1							0	1									0	1
e. Apply interactive and dynamic visualization techniques (I, A)	c		y			y	y	y	y	4			y	c	1	5	c			y	y		1				y		y	y	c	3	3							0	3									0	3
f. Analyze patterns using appropriate methods (I, A)	y		y	y		y	c	y	y	5		y	y	c	2	7	y		y	y	y		3			y	y		y	c	c	3	6							0	6		c				c			0	6
g. Apply strategies to mitigate or constructively engage the effects of uncertainty or partial knowledges (A)	c	c	c						y	0		y			1	1	c	c			y	y	1			y	c					1	2							0	2		c							0	2
h. Interpret data and results using appropriate methods (A)	y	c	y	y	y	y		y	y	6		y	y	y	3	9	y	c	y	y	y		3			y	y	y	y		y	5	7			y				1	8								y	1	8
Goal C: Communication and Engagement **The successful student will be able to share and receive knowledge by engaging with diverse audiences, participants, and stakeholders.**																																																		

1. Disseminate knowledges																																																			
a. Identify modes by which knowledges can be disseminated (B)		c		c		y	y			2				c	0	2		c	c				0						y	y	c	2	1					c		0	1		c		c			c		0	1
b. Recognize that different audiences will have different degrees of familiarity with subject being presented (B)		c		c	c	c	c			0				c	0	0		c	c			y	1					c	c	c	c	0	1		y			c		1	2		c		c	y		c		1	2
c. Summarize an author's argument in their own words (B)										0					0	0						y	1									0	1		y	y	y	y	y	5	6		y		y	y	y	y		5	6
d. Deliver oral presentations (B)		c		c	c	c	c		y	0				y	1	1		c	c		y	y	1					c	c	c	y	1	1		y	y	y	y	y	5	6		c			y		y	y	3	4
e. Adjust the language and technical level of oral or written presentation relative to different audiences (B, I)						c				0				y	1	1						y	1						c		y	1	1		y			c		1	2				y			c		1	2
f. Evaluate the standard modes of dissemination of knowledges for their strengths and weaknesses in a given context (I)		c								0					0	0		c					0									0	0							0	0									0	0
g. Use visual methods to enhance oral or written presentation (B, I)		c		c	c	y	y			2		y		y	2	4		c	c				0			y		c	y	y	y	4	2		y		y	c	y	3	5					y		y	y	3	5
h. Construct other output or products using diverse media, art, activism, or other strategies to convey messages from academic research (I)										0					0	0							0									0	0		c	c	c		y	1	1							y		1	1
i. Synthesize material from several sources (I)						c	c			0				c	0	0							0						c	c	c	0	0		y	y	y	y	y	5	5		c		y	y	y	y		4	4
j. Generate a document that develops an argument drawing from multiple sources (A)										0					0	0							0									0	0		y	y	y	y	y	5	5		c		y	y	y	y		4	4
2. Collaborate in learning and research																																																			
a. Demonstrate responsiveness to others (B)		c		c	c	c	c		c	0				c	0	0		c	c		c		0					c	c	c	c	0	0		y	c	y	y	c	3	3		c	y	c	y		y		3	3
b. Demonstrate ability to work with a division of labor in a collaborative project (B, I)		c		c	c		c		c	0					0	0		c	c		c		0					c		c		0	0		y	c	y	c		2	2			y		y		y		3	3
c. Demonstrate ability to work with people of varying cultures, backgrounds, abilities, ideas, ideals, and status (B, I)							c			0				c	0	0							0							c	c	0	0		y	c	y	c		2	2		c	y	c	c		y		2	2
d. Employ teamwork to achieve results (B, I, A)		c		c	c		c		y	0				y	1	1		c	c		y		0					c		c	y	1	0		y	c	c	y		2	2			y		y		y		3	3
Goal D: Critical Thinking and Ethical Engagement **The successful student is intellectually curious, interested in scrutinizing their assumptions, and is aware of the ethical dimensions of their professional activity regarding real-world problems to work towards justic e.**																																																			
1. Critically engage real-world problems																																																			
a. Identify multiple sides of a problem (B)		c		c		y	y			2				c	0	2		c	c			y	1						y	y	c	2	2		y	y	y	y	y	5	7		y	y	y	y	c	y	c	5	7
b. Explain multiple sides of a problem (I)		c				y	y			2				c	0	2		c				y	1						y	y	c	2	2		y	y	y	y	c	4	6		y	y	y	y	y	y	c	6	8
c. Explain the real-world consequences of different positions regarding a problem (A)		c								0				c	0	0		c				y	1								c	0	1		y	y		c	c	2	3		y	y	y	y	c	y		5	6
d. Develop a position based on an understanding of multiple sides of a problem (A)		c								0					0	0		c				y	1									0	1		c	y	y	c	c	2	3		y	y	c	y	y	y		5	6
e. Identify linkages among apparently discrete problems (A)						y				1				c	0	1						y	1						y		c	1	2		c	c	c		y	1	3		y	c	y	c	c	y		3	5
2. Appraise ethical issues in research																																																			
a. Explain how strategies and methods may be used constructively and destructively in real-world applications (B, I) [identical to b.2.b]		c					y			1				c	0	1		c				y	1							y	c	1	1		y	y		c		2	3		c	c	y	y	c	c		2	3
b. Perceive that everyone, including researchers, implicitly have biases and partial knowledges that can have negative effects on subjects under study (B, I)		c					y			1					0	1		c				y	1							y		1	1		y	y	y	c		3	4		c	c	y	y	c	c		2	3
c. Perceive that subjects under study and those encountered in the field, their values, and their privacy require respect (B, I)										0					0	0						y	1									0	1		c					0	1					c		c		0	1
d. Analyze their positionality regarding, for example, class, race/ethnicity, gender, age, citizenship, occupation, and the like relative those under study or encountered in the field (I, A)										0					0	0						y	1									0	1		c	c	c			0	1							c		0	1
e. Integrate ethical considerations into formulation of questions and applications of their knowledges (S)							y			1					0	1						y	1							y		1	1		c		c			0	1				c		c	c		0	1
Goal E: Professional Development **The successful student understands how to make use of the skills and knowledges developed in their undergraduate program towards securing a job and pursuing a career.**																																																			
1. Make use of their values to guide their careers																																																			
a. Identify their value systems relative to career opportunities (B)										0	c				0	0						y	1		c							0	1							0	1								c	0	1
b. Describe tensions between their ideals and career realities (I)										0	y				1	1						y	1		y							1	2							0	2									0	2
c. Appraise the variety of options and trade-offs in career paths relative to their value systems (A)										0	c				0	0						y	1		c							0	1							0	1									0	1
2. Deploy their skills relative to a changing job market																																																			
a. Identify the range of their skills relative to a variety of career paths (B)				c			c			0	c				0	0			c			y	1		c					c		0	1							0	1								c	0	1
b. Identify the strengths and limitations of their range of skills relative to various professional opportunities (I)				c			c			0	c				0	0			c			y	1		c					c		0	1							0	1									0	1
c. Demonstrate the ability to learn new skills (A)							c			0	c	y			1	1						y	1		c	y				c		1	2							0	2					y			c	1	3
3. Creatively use skills to solve problems beyond those encountered in formal training																																																			
a. Apply knowledge from formal training to examine a problem (B)		c	y	c		c	c	c		1	y	y	c		2	3		c	c	c		y	1		y	y	y		c	c		3	4					y		1	5		c					c		0	4
b. Integrate diverse skills from formal training (I)			y	c				c		1	c		c		0	1			c	c		y	1		c		y					1	2					y		1	3		c			c				0	2
c. Integrate knowledges from formal training with those acquired independently (A)			y					c		1	c		c		0	1				c		y	1		c		y					1	2							0	2							c		0	2

Appendix C. Comparison between the current and revised BS-GIS curricula

Current (33 hours)	Revised (33 hours)
Required courses (8 courses) 4103 Introductory Spatial Data Analysis 5200 Cartography and Map Design 5201 GeoVisualization 5210 Fundamentals of GIS 5212 Geospatial Databases for GIS 5222 GIS Algorithms and Programming 5223 Design and Implementation of GIS 5225 Geographic Application of Remote Sensing	**Core courses (5 courses)** 4103 Introductory Spatial Data Analysis (AU, SP) 5101 GIST Professionalism and Ethics (AU) 5200 Cartography and Map Design (AU, SP) 5210 Fundamentals of GIS (AU, SP) 5225 Geographic application of remote sensing (AU) **Intermediate courses (choose 3 courses, 9 hours)** 4191 Internship in Geography (AU, SP) 5103 Intermediate Spatial Data Analysis (SP) 5201 GeoVisualization (AU, SP) 5212 Geospatial Databases for GIS (AU, SP) 5222 GIS Algorithms and Programming (AU) 5223 GIS Design and Implementation (SP) 5229 Emerging Topics in GIS (AU, SP)
Electives (choose 3 courses) 4191 Internship in Geography 5103 Intermediate Spatial Data Analysis 5226 Spatial Simulation and Modeling in GIS 5229 Emerging Topics in GIS 5XXX One 5000-level topical course in Geography in addition to the courses above CSE 2122 Data Structures Using C++ CSE 2123 Data Structures Using Java CSE 2221 Software I: Software Components CSE 2231 Software II: Software Developments and Design CSE 3241 Introduction to Database Systems CSE 5242 Advanced Database Management Systems	**Electives (choose 3 courses)** *Spatial Data Analytics (choose at least 1 intermediate course and up to 2 from the following to focus)* CSE 2122 Data structures using C++ CSE 2123 Data structures using Java CSE 2221 Software I: Software Components CSE 2231 Software II: Software Developments and Design CSE 3241 Introduction to Database Systems CSE 5242 Advanced Database Management Systems CRPLAN 5320 Introduction to Data Analytics for Transportation Planners PUBAFRS 4040 Public Sector Data Sciences and Management *Urban Studies (9 hours, choose 3 courses to focus)* 5501 Urban Spaces in the Global Economy 5502 Data Justice & the Right to the Smart City 5503 Urban China: Space, Place, and Urban Transformation 5300 Geography of Transportation 5301 Sustainable Transportation *Sustainability (choose 3 courses to focus)* 3597.03 Environmental Citizenship 3702 Life & Death Geographies: Global Population Dynamics 3800 Geographic Perspectives on Environment & Society 5301 Sustainable Transportation 5402 Land Use Geography 5700 Geography of Development 5802 Globalization & Environment 5803 Sustainable Energy Geographies

Appendix D. Current Advising Sheet

THE OHIO STATE UNIVERSITY

Effective Term: AU22

Bachelor of Science
Major: Geographic Information Science

Students majoring in GIS will learn the tools, methods, and software necessary for managing and analyzing geographic information. Students in this major will complete a minimum of 121 hours (including 39 upper division hours) outlined as follows.

General Education Requirements		
Requirement	**Course Options**	**Hours**
GE Launch Seminar	AcadAff 1201	1
Foundations: Writing and Information Literacy	***Student Choice***	3
Foundations: Mathematical & Quantitative Reasoning/Data Analysis	***Math 1151***	5
Foundations: Literary, Visual and Performing Arts	***Student Choice***	3
Foundations: Historical & Cultural Studies	***Student Choice***	3
Foundations: Natural Sciences	***Student Choice***	4-5
Foundations: Social & Behavioral Sciences	***Student Choice***	3
Foundations: Race, Ethnicity and Gender Diversity	***Student Choice***	3
Theme: Citizenship for a Diverse & Just World*	***Student Choice***	4-6
Theme: Student Choice*	***Student Choice***	4-6
GE Reflection	AcadAff 4001	1
	General Education Credit Hours:	**34-39**

College Requirements		
Requirement	**Course Options**	**Hours**
University Survey	**ASC 1100.xx(H)**	1
World Language Foundation	**1101-1103 in any language or equivalent proficiency****	0-12
	Credit Hours:	**1-13**

* Students complete either one 4-credit course or two 3-credit courses in each of two General Education Theme areas: Citizenship for a Diverse & Just World (required), and the student's choice of available GE Themes. If major courses are approved as a GE Theme course, one course in each GE Theme area may double count in the GE and major hours.

**Students must demonstrate proficiency in a language other than English at a level equivalent to 3 semesters of university coursework. Proficiency may be demonstrated by satisfactory completion of coursework, appropriate testing, or language validation. Please see https://cllc.osu.edu/validation-foreign-language-0 and your Academic Advisor for more details.

***Major Pre-Requisites and Co-Requisites may overlap freely with GE Foundations, GE Themes, minors, or certificates when appropriate.

Major Pre-requisites/Co-requisites* **		
Course	**Title**	**Hours**
GEOG 3597.03	Environmental Citizenship *EL: Advanced Writing*	3
	Credit Hours:	**3**

Major Coursework		
Course	**Title**	**Hours**
Major Coursework – Core (24 hours)		
GEOG 4103	Introductory Spatial Data Analysis *EL: Data Analysis*	3
GEOG 5200	Cartography & Map Design	3
GEOG 5201	GeoVisualization	3
GEOG 5210	Fundamentals of GIS *EL: Tech*	3
GEOG 5212	Geospatial Databases for GIS	3
GEOG 5222	GIS Algorithms and Programming	3
GEOG 5223	Design and Implementation of GIS	3
GEOG 5225	Geographic Applications of Remote Sensing	3
Major Coursework – Electives select 3 (9 hours)		
GEOG 4191	Internship in Geography (permission required)	1-5
GEOG 5103	Intermediate Spatial Data Analysis	3
GEOG 5226	Spatial Simulation and Modeling in GIS	3
GEOG 5229	Emerging Topics in GIS	3
GEOG XXXX	Any 5000-level Geography Course	3
CSE 2122	Data Structures Using C++	3
CSE 2221	Software I: Software Components	3
CSE 2231	Software II: Software Development & Design	3
CSE 2123	Data Structures Using Java	3
CSE 3241	Intro to Database Systems	3
CSE 5242	Advanced Database Management Systems	3
	Credit Hours:	33

Open Electives	
Credit Hours:	_____

General Education	**34-39**
College Requirements	**1-13**
Major Pre-requisites/Co-requisites	**3**
Major Coursework	**33**
Required Minor/Certificate	**N/A**
Open Electives	**0**
Total Credit Hours	**Min. 121**

College of Arts and Sciences Policies and General Requirements for Degree

- Students must earn a minimum of 121 total credit hours. Remedial courses (courses at the 10XX level or below, and English 1109) and credit hours earned in repeated course work do not count toward the 121 hour minimum.
- A maximum of 10 hours of non-Arts and Sciences and non-Arts and Sciences-approved course work can be applied to your degree. Of the 10 hours, no more than 4 may be from physical activities courses taught in Education: Physical Activity and Educational Services (KNSFHP); physical activities courses include all 1100 level KNSFHP courses except for 1102, 1103, 1122, and 1137. A maximum of 8 hours of technical credit may be counted toward the 10 hours of non-Arts and Sciences and non-Arts and Sciences-approved course work; however, the combination of KNSFHP, technical, and other non-Arts and Sciences credit hours may not exceed 10.
- Students must complete a total of 39 upper division hours. Upper-division courses are defined as all Arts and Sciences courses at the 3000-level or above, Philosophy 2500, all courses taught by departments in mathematical and physical sciences (Astronomy, Chemistry and Biochemistry, Computer Science and Engineering, Earth Sciences, Mathematics, Physics, and Statistics) at the 2000-level and above (except for courses numbered 2194), and world language courses taught in the language at the 2000-level.
- Students must earn a minimum of 30 credit hours through regular course enrollment at Ohio State.
- Students must earn a cumulative grade point average (GPA) of at least 2.0 for all work attempted at Ohio State. Additionally, students must earn a cumulative GPA of at least 2.0 in their major.

Appendix E. Advising Sheet for the Revised Major

THE OHIO STATE UNIVERSITY
COLLEGE OF ARTS AND SCIENCES

GEOGRAPHY DEPARTMENT

Geographic Information Science (Bachelor of Science)

Geographic Information Science Major

Requires 121 Total Credit Hours; 33 Major Credit Hours; GE New Requirements (AU22 or after)

MAJOR REQUIREMENTS

NOTE: Several major courses are offered only one term per year. Careful schedule planning is required to complete course sequences in a timely manner. Check CSE and GEOG course listings to confirm when courses are offered.

Core Courses: Complete the follow five courses (15 hours)

Course	Title	Hours	Required Prerequisite
GEOG 4103	Introductory Spatial Data Analysis *EL: Data Analysis*	3	Math 1116 or above
GEOG 5101	GIST Professionalism and Ethics *EL: Advanced Writing*	3	None
GEOG 5200	Cartography and Map Design	3	None
GEOG 5210	Fundamentals of Geographic Information Systems *EL: Technology*	3	None
GEOG 5225	Geographic Applications of Remote Sensing	3	None

Intermediate Courses: Choose three of the following courses (9 hours)

Course	Title	Hours	Required Prerequisite
GEOG 4191	Internship in Geography (permission required)	1-5	None
GEOG 5103	Intermediate Spatial Data Analysis – ***SP only***	3	GEOG 4103 *(previously GEOG 5100)*
GEOG 5201	GeoVisualization	3	None
GEOG 5212	Geospatial Databases for GIS	3	None
GEOG 5222	GIS Algorithims and Programming – ***AU only***	3	None
GEOG 5223	GIS Design and Implementation – ***SP only***	3	None
GEOG 5229	Emerging Topics in GIS – ***AU only***	3	GEOG 5210

Elective Courses: Students are encouraged to choose 1 of the following focus areas, but are permitted to complete the required 3 courses elective courses (9 hours) from any following category:

Spatial Data Analytics: *Choose 3 courses to focus (choose at least one intermediate course (in GIS and up to two from the following to focus):*

Course	Title	Hours	Required Prerequisite
GEOG 4191	Internship in Geography (***permission required***)	1-5	None
GEOG 5103	Intermediate Spatial Data Analysis - ***SP only***	3	GEOG 4103 (previously GEOG 5100)
GEOG 5201	GeoVisualization	3	None
GEOG 5212	Geospatial Databases for GIS	3	None
GEOG 5222	GIS Algorithims and Programming – ***AU only***	3	None
GEOG 5223	GIS Design and Implementation – ***SP only***	3	None
GEOG 5229	Emerging Topics in GIS – ***SP only***	3	GEOG 5210
CSE 2122 or CSE 2123	Data Structures Using C++ or Data Structures Using Java	3	CSE 1222 CSE1223
CSE 2221	Software I: Software Components	3	CSE 1223
CSE 2231	Software II: Software and Development	3	Prereq: 2221, Concur: 2231
CSE 3241	Introduction to Database Systems	3	CSE 2133 or 2231 & 2321 or Math 2366
CSE 5242	Advanced Database Management Systems	3	CSE 3241 or 5241 & 2421 or 5042
CRPLAN 5320	Intro. to Data Analytics for Transportation Planners	3	None
PUBAFRS 4040	Public Sector Data Sciences and Management	3	None

Urban Studies *– choose 3 courses for area focus*

Course	Title	Hours	Required Prerequisite
GEOG 5300	Geography of Transportation – ***AU only***	3	None
GEOG 5301	Sustainbale Transportation – ***SP only***	3	None
GEOG 5501	Urban Spaces in the Global Economy – ***AU only***	3	None
GEOG 5502	Data Justice and the Right to the Smart City – ***SP only***	3	None
GEOG 5503	Urban China: Space, Place and Urban Transformation – ***AU only***	3	None

Sustainability *– choose 3 courses for area focus*

Course	Title	Hours	Required Prerequisite
GEOG 3597.03	Environmental Citizenship	3	None
GEOG 3702	Life & Death Geographies: Global Population Dynamics	3	None
GEOG 3800	Geographic Perspectives on Environment and Society – ***SP only***	3	None
GEOG 5301	Sustainbale Transportation – ***SP only***	3	None
GEOG 5402	Land Use Geography – ***AU only***	3	None
GEOG 5700	Geography of Development – ***SP only***	3	None
GEOG 5802	Globalization and Environment – ***SP only***	3	None
GEOG 5803	Sustainable Energy Geographies – ***AU only***	3	None

GENERAL EDUCATION (NEW) REQUIREMENTS

Requirement	Course Options	Hours
GE Launch Seminar *(First Year)*	ACADAFF 1201	1
Foundations: Writing and Information Literacy	Student Choice	3
Foundations: Mathematical & Qualitiative Reasoning/Data Analysis	MATH 1151: Calculus I	5
Foundations: Literacy, Visual, and Performing Arts	Student Choice	3
Foundations: Historical and Cultural Studies	Student Choice	3
Foundations: Natural Sciences	Student Choice	4-5
Foundations: Social & Behavioral Sciences	Student Choice	3
Foundations: Race, Ethnicity, and Gender Diversity	Student Choice	3
Theme: Citizenship for a Diverse and Just World*	Student Choice	4-6
Theme: Student Choice*	Student Choice	4-6
GE Relfection Seminar *(Fourth Year)*	ACADAFF 4001	1

* NOTE: See General Education Requirements notes on page 3 for specifications.

COLLEGE OF ARTS AND SCIENCES REQUIREMENTS

Requirement	Course Options	Hours
College Survey *(First Semester)*	ASC 1100.xx (H)	1
World Language Proficency**	1101-1103 in any language or equivilant proficiency	0-12

* See College Requirement notes on page 3 for specifications.

DEGREE REQUIREMENT SUMMARY

Requirement Area	Hours
General Education Requirements	34-39
College Requirements	1-13
Major Coursework	33
Open Electives	36
Total Credit Hours *(including 39 Upper Division)*	**Min. 121**

Major Requirements

The following requirements for the major apply to all Arts and Sciences degrees.

Major requirements comprise at least 30 semester hours and can be substantially higher. Major courses must be at the 2000 level or above. At least 20 hours of the major must be in courses offered by the department of the major. Note: Some interdisciplinary majors are excluded from the 20-hour rule.

Students must earn at least a C- in a course for the course to apply to the major. However, students must receive a 2.0 cumulative grade point average (GPA) for all major course work. If a D+, D, or an E is earned in a course needed for the major, the course cannot be counted on the major. The major advisor will decide if the course should be repeated or if another course should be substituted. Courses taken on a pass/non-pass basis cannot be used on the major.

The department must approve all courses in the major. Some departments require a "major program form," a document that must be signed by the academic advisor and submitted with the graduation application. Some departments do not require such a form because the academic advisors use an automated version on the degree audit report. Some departments require both. In any case, students should meet with the academic advisor early to plan the major; during your meeting, it can be determined whether the department requires a paper major program form. Any changes or adjustments to the major should be made in consultation with the academic advisor.

If a student transferred from another institution, no more than half of the credit hours on the major program may consist of transfer credit. The academic advisor, the chairperson of the department, and the appropriate assistant dean must approve any request for a variation in this policy.

For Honors students, the GE curriculum and major must be approved by the assigned Honors advisor. Information about the honors curriculum and requirements and how to schedule an appointment with an honors advisor is available on the College of Arts and Sciences Honors Program website: http://aschonors.osu.edu/advising. Students will also be assigned a faculty advisor in the department of study to help the student choose courses and co-curricular opportunities that align with academic and professional goals.

General Education and ASC College Requirements

***Students complete either one 4-credit course or two 3-credit courses in each of two General Education Theme areas:** Citizenship for a Diverse & Just Word (required), and the student's choice of available GE Themes.

****Students must demonstrate proficiency in a language other than English at a level equivalent to 3 semesters of university coursework.** Proficiency may be demonstrated by satisfactory completion of coursework (1101-1103), appropriate testing, or world language validation. Please see https://ciic.osu.edu/validation-foriegn-language-0 and your Academic Advisor for details.

For more information about internship and career opportunities, visit the College of Arts and Sciences Career Services Office. Their website is http://asccareerservices.osu.edu/ .