Soils and Landscapes GEOG 4220/5220
Fall 2023 V2

This syllabus is subject to change over the course of the semester…

Lecture:	Wed. 14:00 to 14:50	Latham Hall 133
Lab:	Friday 14:00 to 16:50	
Professor:	Dr. Chad E. Heinzel	Latham Hall 116/126
Office hours:	M, W, F 9:00 to 9:50, and by appointment	
Office phone:	273-6168	
Email:	chad.heinzel@uni.edu	
Social Media:	Twitter @Ubreccia Facebook: UNI Earth and Environmental Sciences Dept.	
Text:	Required: Soils: Genesis and Geomorphology, by Schaetzl and Anderson (SA) Soil Genesis and Classification 6th ed., Buol, Southard, Grahm, McDaniel (BSGM) Other resources: The Nature and Properties of Soils, by Weil and Brady	
Credits:	Three - This course meets the Course Credit Hour Expectations outlined in the Course Catalog. You should expect to work approximately 2 hours per week outside of class for every course credit hour, (so at least 6 hours per week).	
Final Exam:	**Monday, December 11, 3:00-4:50, Latham 133**	

UNI Soils and Landscapes Learning Outcomes -
A. Discover the relationships between geology, biology & chemistry through the interface of soil.
B. Characterize soil properties, developments & applications through multiple disciplines.
C. Name soils & interpret their landform assemblage associations/changes over space/time
D. Understand how soil serves as our civilization's foundation. Work to appreciate and value soil.
E. Apply Geographic Information Systems toward soil characterization, interpretation and mapping.

Additional student goals:
Appreciate soil as a complex natural resource
Develop soil description skills that are applicable worldwide
Obtain a working knowledge of soil taxonomy
Understand how soil form under different environmental conditions
Understand and recognize soil-geomorphic spatial patterns across landscapes
Be able to utilize Soil Survey Information
Develop an understanding for the use of soils in Quaternary investigations

Course Description –
Study of soils as result of inter-relationships among climates, ecosystems, and landscapes of the world. Soil formation, distribution, properties, and classification, and applications of soil geography to other disciplines. Lecture, 2 periods; lab/field trips, 2 periods. Prerequisite(s): EARTHSCI 1300 or GEOG 1210; junior standing. (Odd Falls)

This course focuses on the origin/evolution of soil through biological, chemical and physical landscape processes. Each topic will relate to the following recurring themes that we use as guiding principles for the course: laws of conservation, transport rules, and event magnitude/frequencies. The course will begin with the "big picture" view of soil development.

Class Schedule – Subject to minor changes throughout the semester

		Text/Reading
Week One (Aug. 21/25)	Introduction – Soil History and Importance L*ab*: Introduction to Soil Toolbox Soil Profile Description Handouts	Chapter 1 (BSGM) & (SA)
Week Two (Aug. 28/1)	Soil morphology and composition Lab: Developing soil characterization skills Horizon Nomenclature (BSGM 35-37) Soil Color (BSGM 37), Texture (BSGM 38-41) Structure (BSGM 41-43), Consistence (BSGM 42) Boundaries (BSGM 44-45)	Chapter 2 (BSGM)
Week Three (Sept. 4/8)	Soil horizonation Lab: Field trip 1 – Black Hawk Co. Parks UNI closed - Monday May 4 Soil Horizon Designations/Master Horizons (BSGM 45-47) Subordinate horizons (BSGM 47-50) Diagnostic soil materials for horizons and classification (BSGM 51-62) Field Sampling for Laboratory Analyses (BSGM 63-65)	
Week Four (Sept. 11/15)	Laboratory determinations (BSGM 65-76) Lab: Laboratory Analyses Soil micromorphology (BSGM 76-80) Dynamic soil properties (BSGM 80-87)	
Week Five (Sept. 18/22)	Soil classification and taxonomy (BHMS Ch. 7) Lab: Soil taxonomy Alfisols (BSGM Ch. 8) Andisols (BSGM Ch. 9) Aridisols (BSGM Ch. 10) Entisols (BSGM Ch. 11) Gelisols (BSGM Ch. 12) Histosols (BSGM Ch. 13) Inceptisols (BSGM Ch. 14) Mollisols (BSGM Ch. 15) Oxisols (BSGM Ch. 16) Spodosols (BSGM Ch. 17) Ultisols (BSGM Ch. 18) Vertisols (BSGM Ch. 19)	
Week Six (Sept. 25/29)	Soil classification, mapping and soil surveys (BSGM Ch. 20, SA Ch.7) Lab: Field trip 2 – Jackson County 1	
Week Seven (Oct. 2/6)	Parent Materials Lab: Test 1	
Week Eight (Oct. 9/13)	Weathering and Pedoturbation Lab: Soil Geochemistry	(SA Ch. 9 & 10)
Week Nine (Oct. 16/20)	Climate and Soil models Lab: Soil - Homecoming	(SA Ch. 11 & 12)
Week Ten (Oct. 23/27)	Geomorphology and Hydrology Lab: Field trip 3- Jackson County 2	(SA-Chapter 13)
Week Eleven (Nov. 30/3)	Soil chronostratigraphy Lab: ???	(SA-Chapter 14)

Week Twelve (Nov. 6/10)	Paleosols and Paleoenvironmental reconstructions Lab: ???	(SA-Chapter 15)
Week Thirteen (Nov. 13/17)	Quaternary History and Soils of the upper Midwest Lab: Exam 2	
Week Fourteen	***Fall Break*** **(Nov. 20-24)**	
Week Fifteen *(Nov. 27/1)*	Soil and Humanity: agriculture Lab: ???	
Week Sixteen (Dec. 4/8)	Soil and Humanity: mining and construction Lab: ???	
Week Seventeen (Dec. 11/15)	**Final Exam 3 (Comprehensive)** **Monday, December 11, 3 to 5, Latham 133**	

Grading procedures and policies

A >93%, A->90%
B+>87%, B >83%, B->80%
C+>77%, C >73%, C->70%
D+>67%, D >63%, D->60%
F < 60%

If you earn 93% of the total points you are guaranteed a grade of A. The lower limit for each grade range will not move up. **A curve will not be used in this class.**

There will be no make-up exams after the scheduled exams are given. Should you have a scheduled conflict, please visit with me at least two weeks before the exam date. An unexcused absence during an exam will lead to an automatic zero. If there is an emergency, we will work together on a solution.

Estimated Point distribution

		Est. Points
Tests	#1 @ 100	= 100
	#2 @ 100	= 100
+ Final exam	#3 @ 150	= 150
Homework, Field reports	350	= 350
	Total =	**700 points**

A = 650; B = 575; C = 500; D = 425

Class Attendance and Participation

Course questions will reflect and cover class 1) discussions, 2) field and lab activities, 3) text/journal readings, and 4) small group activities. Anything I say/discuss is fair game for a quiz or exam. Attendance is essential. If you listen, ask questions, take very good notes, and study for tests chances for earning a good grade are high! And the general guidelines of UNI's attendance policy will be employed, https://policies.uni.edu/306).

UNI – Statements for Student Success

UNI Information and regulations regarding Free Speech, Equity, Accessibility, The Learning Center and potential Covid guidelines should be accessed here… https://provost.uni.edu/syllabus-statements

Additional recommendations from UNI's Center for Excellence in Teaching & Learning

A. Course materials, accessibility and opportunities for enhanced success

a. Textbooks – digital pdfs will be provided.

b. Computers, GIS software and data – Computers and necessary software will be available in the Latham Hall first floor computer lab. The following websites will be useful for gathering GIS & data: 1. https://geodata.iowa.gov/, 2. http://ortho.gis.iastate.edu/ , 3. https://www.iihr.uiowa.edu/igs/geosam/home, 4. https://www.geotree.uni.edu/en/

c. Field trips – We will work to have field trips most, but not all Fridays.

d. Course webpage – You will have access to some course materials and additional learning resources through the following webpage - https://www.exploreiowageology.org/UNI_Soil.php

e. UNI-E-Learning – https://elearning.uni.edu/, This software will be used to help you keep track of your course progress - primarily scores from homework, fieldwork, tests, etc.

B. Classroom civility –

a. Be respectful to everyone at all times.

b. Be on time, pay attention (do not hold side conversations during class), and participate.

c. Represent UNI well when on and off campus.

d. Reduce use and silence phones in class and during field trips.

C. Pro-Tips for doing well in this class

- Everyone learns differently, I will do my best to use effective methods generally help students learn geomorphic concepts, if you are struggling to learn the material, are confused by the structure of our content or just overwhelmed let me know ASAP.
- If you are new to using GIS, ask for additional assistance.
- Do the reading assignments before you come to class! I may ask 2 to 4 test questions directly from the textbook readings - that may not be specifically discussed in class.
- Be a good detective, the concepts that you will be learning are connected, so if you don't understand a concept (early on) make sure you ask questions, because you will be applying that knowledge again and again.
- Take great notes, a lot of information will be coming your way.
- Ask a lot of questions in lecture and lab.

Concepts of Soil Genesis after (BSGM)

Concept 1. Soil-forming processes, also referred to as pedogenic processes and biogeochemical processes, that are active in soil today have been operating over time and have varying degrees of expression over space/landscapes. The geologic uniformitarian principle states 'the present is the key to the past' is also applicable in soils with respect to the downward translocation, biocycling and transformation of materials - back to the time of appearance of organisms on the land surface. We can improve our elucidation of soil formation of differing profiles by application of this principle.

Concept 2. Many soil-forming (and soil-destroying) processes proceed simultaneously in a soil, and the resulting soil properties reflect the balance of both present and past processes (Simonson, 1959). Soil forming processes are actually combinations of specific reactions that are characteristic of particular time spans and conditions.

Concept 3. Distinctive combinations of geologic materials and processes produce distinctive soils. Observable morphological features in a soil are produced by certain combinations of pedogenic processes over time. The degree to which a morphological feature is expressed is dependent on the intensity and duration of the process.

Concept 4. Five external factors provide the reactants and energy to drive the pedogenic processes within a soil. These factors are climate, organisms, relief, parent material and time.

Concept 5. Present day soils may carry the imprint of a combination of geologic and pedogenic processes not presently active at that site. Therefore, knowledge of paleoecology, glacial geology and paleoclimatology is important for the recognition and understanding of soil genesis.

Concept 6. A succession of different soils may have taken placed at a particular spatial location as soil-forming factors changed. The soil surface is lowered by erosion and dissolution of soil material and elevated by deposition of soil materials and tectonics. In this respect, the volume of material examined as soil on the land surface actually changes in vertical space over time.

Concept 7. The time scale for soil formation is much shorter than the geologic time scale and much longer than the age span of most biological species. The vulnerable position of soil as the skin of our dynamic earth subjects it to destruction and burial by episodic geologic events. Few, if any, soils are older than Tertiary and most no older than the Pleistocene. Succession of vegetative communities and human activities often alter properties over short spans of time.

Concept 8. Complexity of soil genesis is more common than simplicity. Some processes that influence soil compositions are discontinuous or episodic and disrupt soil features formed by other processes that are rather continuous over time.

Concept 9. Soils are natural sites for clay mineral formation on land surfaces. Most primary mineral on earth crystallize from magma at high temperatures and pressures in the absence of free oxygen. When exposed to lower temperatures and pressures, primary mineral decompose by weathering processes. Some of the elements reassemble into new mineral structures of clay-size. It is likely that the clay particles in shale and other sedimentary rocks are products of mineral alteration is soil prior to erosion and deposition.

Concept 10. Understanding and knowledge of soil genesis is useful in soil classification and mapping, but scientific classification systems cannot be based entirely on inductive concepts of soil genesis. Processes operating within a soil can seldom be observed or measured and are subject to change over time which renders quantification difficult if not impossible.

Concept 11. Knowledge of processes of soil formation is basic to understanding the impact of human use and management. Humans alter both factors and processes of soil formation in the attempts to improve a sols' performance for specific purposes. Knowledge of pedogenic processes helps assure compatibility of human actions and ambient soil conditions.

Geomorphology
Fundamental Concepts - after C.L. Matsch (U. of MN-Duluth)

Concept 1. The same physical processes and laws that operate today have operated throughout geologic time, although not necessarily always with the same intensity as now. (Uniformitarianism)

Concept 2. Geologic structures are a dominant controlling factor/variable in the evolution of landforms and they are reflected in them.

Concept 3. To a large degree the Earth's surface relief is a product of geomorphic processes operating at differential rates.

Concept 4. Geomorphic processes leave their distinctive imprint upon landforms, and each geomorphic process develops its own characteristic assemblage of landforms.

Concept 5. Various erosional agents force their 'will' upon the Earth's surface producing an orderly sequence of landforms.

Concept 6. Complexity in geomorphic evolution is more common than simplicity.

Concept 7. Little of the Earth's topography is older than the Tertiary (66 to 2.6 Ma) and most of it is no older than the Pleistocene (past 2.6 Ma).

Concept 8. Proper interpretation of present-day landscapes is impossible without a full appreciation of the geologic and climatic manifold of changes that occurred throughout the Pleistocene.

Concept 9. An appreciation of the Earth's climatic variance is necessary to form a proper understanding of the evolving importance of its different geomorphic processes.

Concept 10. Geomorphology, although concerned primarily with present-day landscapes, attains its maximum usefulness by historical extension and/or predictive modeling.

Climate Principles - You shouldn't leave this course without applying these!

Principle #1 Humans can take actions to reduce climate change and its impacts.
Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation. Steps toward reducing the impact of climate change may influence the present generation by providing other benefits such as improved public health infrastructure and sustainable built environments.

Principle #2 The Sun is the primary source of energy for Earth's climate system.
Sunlight reaching the Earth can heat the land, ocean, and atmosphere. Some of that sunlight is reflected back to space by the surface, clouds, or ice. Much of the sunlight that reaches Earth is absorbed and warms the planet.

Principle #3 Climate is regulated by complex interactions among components of the Earth system.
Earth's climate is influenced by interactions involving the Sun, ocean, atmosphere, clouds, ice, land, and life. Climate varies by region as a result of local differences in these interactions.

Principle #4 Life on Earth depends on, is shaped by, and affects climate.
Individual organisms survive within specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish.

Principle #5 Climate varies over space and time through both natural and man-made processes.
Climate is determined by the long-term pattern of temperature and precipitation averages and extremes at a location. Climate descriptions can refer to areas that are local, regional, or global in extent. Climate can be described for different time intervals, such as decades, years, seasons, months, or specific dates of the year.

Principle #6 Our understanding of the climate system is improved through observations, theoretical studies, and modeling.
The components and processes of Earth's climate system are subject to the same physical laws as the rest of the Universe. Therefore, the behavior of the climate system may be understood and predicted through careful systematic study.

Principle #7 Human activities are impacting the climate system.
The overwhelming consensus of scientific studies on climate indicates that most of the observed increase in global average temperatures since the latter part of the 20th century is very likely due to human activities, primarily from increases in greenhouse gas concentrations resulting from the burning of fossil fuels.

Principle #8 Climate change will have consequences for the Earth system and human lives.
Incidents of extreme weather are projected to increase as a result of climate change. Many locations will see a substantial increase in the number of heat waves they experience per year and a likely decrease in episodes of severe cold. Precipitation events are expected to become less frequent but more intense in many areas, and droughts will be more frequent and severe in areas where average precipitation is projected to decrease.

Climate – www.cleanet.org