ENVIRONMENT AND NATURAL RESOURCES 5272
Turfgrass Soils
2 Credit Hours

Course Instructor:

Dr. Ed McCoy
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Face-to-face meetings are by appointment.

Times and Location:

This is a completely on-line course offered through Carmen. The course is self-paced yet all course requirements must be completed during the semester of offering.

Student Learning Goals:

Students gain an understanding of unique requirements of turfgrass soils and the scientific principles upon which these soils are designed and constructed. Students learn the fates of water in highly manipulated anthropogenic soils and the fascinating manner by which water is managed in constructed turfgrass soils. Students learn the historical developments in specific use turfgrass soils and the current design guidelines of the more popular systems. The students are enabled to assess future developments in turfgrass soil systems through their knowledge of applicable soil principles.

Expected Learning Outcomes:

1. Students gain an understanding of the unique requirements of turfgrass soils in supporting plant growth and providing a playable surface.
2. Students learn the dependence of soil strength on soil composition and wetness, and how these dependencies differ between compressive and shear stresses.
3. Students gain an appreciation for the role of sand and amendments in turfgrass soils and learn methods to judge their quality.
4. Students discover the scientific principles upon which some of the more popular soils for high-traffic situations are designed.
5. Students learn the theory and common practices for drainage of turfgrass soils.

Learning goals and objectives will be satisfied through delivery of voice-over-PowerPoint lecture modules, animations of water flow through soil, assigned readings, exams and an independent project.
Course Description:

Managed turfgrass soils, consisting principally of golf courses and athletic fields, are unique soil systems in that they 1) exist on manipulated landscapes, 2) may contain purposely crafted soil materials and profiles, 3) are exposed to frequent human contact and 4) are often subject to performance expectations with regard to the play of the game. Consequently, the purpose of this course is to examine these unique soils focusing on their physical properties and processes. The rationale for this focus is because physical property problems are commonly observed and can be quite expensive to resolve within man created soils. The course will principally cover Soil Science principles as applied to these turfgrass landscapes. Soil management practices, while occasionally mentioned will be given lesser coverage as it is the instructor’s belief that sound management and innovation result from an understanding of the underlying scientific principles.

As a point of reference the course will open with a discussion of the soils and geomorphology of the linksland, the ancestral home of golf, and the historical development of athletic playing surfaces. Besides representing the archetype for venues of the modern game, these landscape surfaces impact both the quantity and velocity of surface runoff.

Earthmoving during construction and foot and vehicle traffic during maintenance and play generates forces acting on the soil. How the golf course and athletic field soil responds to these forces will dictate the degree of soil compaction and loss of soil structure that may result. Understanding how soils respond to external forces requires some knowledge of soil mechanical properties and their relation to texture and moisture. Soil mechanics also influences play of the game through both player-surface and ball-surface interactions.

Owing to the importance sand in avoiding compaction and providing improved playability, sands are widely employed in crafting golf course and athletic field root zones. Additionally, specific applications within these venues commonly have exacting specifications outlining which sand materials are suitable for a specific use. Consequently, insight into how sands are described is needed to properly understand these specifications. While specifications for organic materials and other amendments are not so exacting, understanding of the characteristics of these materials in also needed to better direct their use.

It is fairly unique within the scope of Soil Science to consider crafting a soil by combining sands, fine soil materials, organic matter and other amendments. Yet this process commonly occurs in developing a managed turfgrass soil. Interestingly, Soil Science principles and past research can be employed to describe the generalized behavior with regard to soil physical and mechanical properties of the bulk soil resulting from this manufacturing process. Because the goal of soil design and modification is commonly to impact both soil water retention and permeability, a review of soil water principles will also be included in the course.

It is the author’s judgment that no single soil material represents the ideal root zone for a golf green or athletic field. Rather, a range of soil materials would adequately serve as root zones to meet the agronomic and performance expectations of individual playing surfaces. Employing the tools of previous chapters, this range of soil materials and their corresponding physical properties will be thoroughly described. In addition, specific examples such as the USGA root zone and the
so-called pure sand root zone will be described; including an illustration of how these examples fit within an overall scheme. Because the specifications of these root zones are based on a set of testing protocols, a coherent discussion of the testing methods and their interpretation will accompany this discussion.

Managed turfgrass soils encompass more than just the root zone. For optimum performance of a putting green or athletic field, you need also to consider issues such as the presence or absence of a gravel drainage layer underlying the root zone and the depths of each. Because this soil profile layering can have a large impact on soil aeration, a discussion of the scientific principles of soil gas exchange with the atmosphere will be presented. As with the previous discussion on root zones, specific soil profile examples, such as the USGA and California putting greens, that currently exist in the industry will be described.

Water is constantly in motion within layered soils designed for high traffic areas of the golf course or athletic field. Yet the layering of highly contrasting soil materials within these systems can have a profound effect on the rates and direction of water flow. Consequently the course will contain a discussion of the field water cycle including processes such as infiltration, drainage and turfgrass water uptake.

**Course Materials:**

A formal textbook does not exist for this subject area. A set of reading materials by the instructor, including “Golf Course Soil and Water Science”, “Commercial Amendments for Sand-Based Root Zones” and the manual “Drainage Systems for Golf Courses” are available on Carmen. Lecture handouts are also available and these should be printed and used to follow along with the on-line lectures and record notes. All animations and videos presented during the on-line lectures will also be included on Carmen for independent viewing. Finally, seminal publications in this subject area by the instructor are also uploaded to Carmen. Please check Carmen for updates throughout the semester.

**Prerequisites:**

Not open to students with credit for ENR 540.

**Course Content:**

On-line delivery of voice-over-PowerPoint modules will serve as the lecture component of the course. The objective of the lecture modules is to present and clarify important principles and concepts in a stepwise, knowledge-building fashion. The modules will be accessed and run from Carmen in via asynchronous delivery allowing self-paced student learning. However, the modules are designed to be viewed sequentially providing an accumulation of knowledge throughout the semester.

To keep students on-pace with completion of all course requirements by the end of the semester, two midterm exams will be scheduled following the 6th (covering lectures 1 through 13) and 11th
(covering lectures 14 to 24) weeks of the semester. Your study, throughout the course, of about 2 lectures per week will keep you on track for completing the course requirements.

Reading assignments from the various course materials are intended to compliment the on-line modules and will be referenced on the Carmen page for the course. Students are responsible for subject matter covered in the lecture modules, assigned readings, and handouts.

**Assessment Format:**

The course will be assessed using performance on two midterm exams, a comprehensive final and an independent project. The midterm and final exams will be offered on-line during a specified 3-day exam window. Also, each examination instance will span a fixed time interval and exam can only be taken once. Only students presenting a valid excuse will be allowed access to the exam outside of the specified exam window. Appropriate allowances will be made for students certified by the Office for Disability Services.

The independent project is to assemble a turfgrass soils photo album. The purpose of this project is for the students to interact, document and describe turfgrass soils within their natural setting. It is accomplished by visiting 3 to 5 golf course or athletic field sites, withdrawing the soil using a coring tool, taking a digital photograph of the exposed soil profile, and writing a brief paragraph describing each photograph.

An example report will be posted on Carmen. The heading for each photo should identify the type of playing surface the photograph was collected from. The photo is then inserted into the report. The paragraph under the photo should document 1) the location where the sample was collected, 2) the date, 3) the depths of the layers, 4) the composition of the layers, and 5) any comments relating to the condition of the soil.

The project will be graded by evidence of the though put into selecting interesting sites, by completeness of documenting the soil condition, and by interpretation of the quality of the soil for its intended playing surface.

The report consisting of photos and their descriptions are to be submitted via the Carmen drop box no later than 11:59 pm on the last day of classes. If for whatever reason you perceive this project impossible to accomplish, contact me and we can arrange for a suitable alternative.

**Assignment of Letter Grades:**

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<tr>
<th>Task</th>
<th>% of Grade</th>
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<tbody>
<tr>
<td>Midterm Exams (2)</td>
<td>50</td>
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<tr>
<td>Final Exam</td>
<td>30</td>
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<td>Class Project</td>
<td>20</td>
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The grading scale is A=90%, B=80%, C=70%, D=60%, E less than 50%.
Course Lectures and Their Sequence:

The following is a listing of the course lectures. It is expected that students will view and study about 2 lectures per week. Students can, however, complete each module at their own pace provided they are prepared for the midterm exams and all course requirements are completed by the end of the semester. The information presented in this course is arranged sequentially so students should review the materials in order. Finally, it is recommended that students view each lecture twice, once, slowly to record notes, and a second time more quickly to review the material. This level of effort should be equivalent to a 2 semester credit face-to-face course.

1. Soils and Geomorphology of the Linksland
2. Quantity of Surface Water Runoff
3. Rates of Surface Water Runoff
4. Traffic and its Effects on Soils
5. The Compressive Strength of Soils
6. The Shear Strength of Soils
7. Soil Compaction
8. Root Zone Shearing – Athletic Fields
9. Root Zone Shearing – Golf
10. Sand
11. Sand Particle Sizes and Uniformity
12. Sand Particle Shape and Mineralogy
13. Amendments for Sand-Based Root Zones
14. Soil Water Principles – Water Content
15. Soil Water Principles – Water Retention
16. Soil Water Principles – Water Permeability
17. Layered Soils
18. Principles of Subsurface Drainage
19. Alternative Fairway Drainage Approaches
20. Root Zones for High Traffic Turfgrass Areas
21. Performance Attributes for Root Zones
22. Athletic Field Root Zones
23. 3 Root Zones for High Traffic Areas
24. Topdressing Sands
25. Soil Profiles for High Traffic Turfgrass
26. 3 Soil Profile Examples, Part 1
27. 3 Soil Profile Examples, Part 2
28. Soil Water in USGA Putting Greens
29. Soil Water in California Putting Greens
30. Soil Water in Push-Up Greens
31. Putting Green Drainage

Academic Misconduct:

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term
“academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

Disability Services:

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor of their needs as soon as possible. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Ave.; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.