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From: R.W. Arnold
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Re: Course sequence in a Soils orientation.

At present the students do not indicate a Soil Science major or orientation. The pensum services students with many different interest but it offers nothing to students in other disciplines.

The following proposal is based on the assumption that students should be offered a Soil Science orientation. In attempting to provide a stronger program which could terminate with an Ingeniero Agronomo degree it is believed desirable to increase the in-depth training of the subject matter of soils to provide a background more suited to the anticipated needs of such students. These needs include: an increased awareness of soil as a vital resource in our total environment, a better understanding of the interactions that result in increased crop production, and improved understanding of how and why various segments of societies utilize knowledge about soil systems.

A major problem in Soil Science, as in most areas of inquiry, is that vast amount of raw information overwhelm the few comprehensive and trusted systems of knowledge which we have perceived and developed. We are all very aware of the magnitude of unassimilated, and often unmanageable information, that innundates us while we thirst for understanding. Where do individuals turn for guidance in comprehending the dynamic interrelationships that lead us to the solutions of our modern problems? Improved and changing curricula are a starting point.

This proposal suggests some courses based on assumed student needs in the future, and includes:

a) a History of Agriculture course for all Agriculture students

b) a revised Introductory Soils course

c) two courses dealing with soil as a system; one concentrating on chemistry and biology, the other concentrating on physics and pedology

d) two courses dealing with soil management; one concentrating on agricultural production, the other concerned with non-farm uses

e) two courses dealing with the interplay of the discipline with society; one concerned with the applications of Agronomia, the other exploring some interactions of Soil Science and segments of society.

f) the use of Special Topic courses to provide additional emphasis in subject matter of interest to students.

Possible Scheduling of Courses in Soils Orientation

This is not a curriculum for a students program but merely an indication of the timing that might be consistent with the students background and level of teaching expected.

Semester	Course	Credits
1º	History of Agriculture	2
2º	(nothing)	-
3º	Introductory Soils	4
* 4º	Introductory Geology	4
5º	Applications of Agronomia (by specialties or departments)	3
* 6º	Soil Systems I: Chemistry and Biology	4
* 7º	Soil Systems II: Pedology and Physics	4
* 8º	Non-farm Soil Management (Special Topics)	3 (1 or 2)
* 9º	Agricultural Soil Management	4
10º	Soil, Ecosystems, and Society (Special Topics)	2 (1 or 2)

* These courses provide the special Soils Orientation.

History of Agriculture

2 credits

Students in the field of Agriculture need: (a) to be aware of the traditions and development of agriculture throughout man's history, (b) to appreciate the patterns and practices of land tenure in various times and places, (c) to understand the increasing role of science and technology in the development of modern agriculture, and (d) to know of the challenges of the present.

This course can act as a stimulus for students opting for Agronomia, and for others it may help them decide that some other area of academics is of more interest.

The major objective is to satisfy the needs of students stated above. It likely would be most successful if tought by a dynamic engaging teacher who is sincere and enthusiastic about the subject matter.

No specific outline of material is proposed here, however, a very popular and successful course of such a kind has been tought by the Natural Sciences Department at the University of Guelph, Guelph, Ontario, Canada for a number of years.

It is suggested that two one-hour lectures a week be devoted to this course.

Soil Science — Introductory Course

4 credits

Students who are being introduced to Soil Science need: (a) to obtain an appreciation of what the discipline encompasses in both subject matter and approaches; (b) to understand how soils relate to the environment; (c) to be aware of some society's desires in using their soil resources; and (d) to be aware of careers or occupations associated with the study of soils as a science.

For many students this may be the only contact with Soil Science in an academic setting, for some it may be the spark that ignites the mind into a new pursuit, and for a few it is the basis on which a continuing program in Soil Science is founded.

The major objective is to satisfy the above stated needs of students. The main emphasis is on introducing all facets of Soil Science to students. However, the aspects of (a) why, how, and who conducts soils research and (b) translating such information into solutions of pragmatic problems facing soil resources users are considered to be integral portions included in all subject matter areas where pertinent.

It is recognized that the subject matter may be divided or grouped at will, therefore, the following is merely to facilitate discussion and focus on expected response of students.

Subject Matter	Desired Student Response
A. Concept of Soils	Become acquainted with both historical and current concepts of soils as they relate to agriculture, other disciplines, and society in general. Be aware of soil as a component in the ecosystem.
B. Chemical and Physical Properties	Be familiar with the major recognized properties of soil; understand why and how to measure certain properties such as CEC, pH, texture, porosity, solid-solute interactions, etc.
C. Soil Biology	Appreciate the importance of biological processes occuring in soils and the role of microorganisms as agents of transformation. Awareness of soil as part of the ecosystem and relationship to environmental quality.
D. Soil Development and Classification	Recognize the relationships between concepts of soil genesis and classification, survey, geography, and interpretation of soils. Appreciate systems designed to organize soils information.
E. Use and Management of Soils	Be familiar with methods and approaches to modify soils to obtain desired responses. What are needs of agriculture; why and how are soils changed for agriculture? What are needs for non-farm uses; why and how are soils changed for these needs?

Application of Agronomía

3 credits

Objective: To serve a motivation-oriented course in introducing students to the relations of Agronomía with present-day agriculture.

Students Needs: It is thought that it is important for students (especially in the 2nd or 3rd year) to have a course that (1) has a modest field trip program permiting active student participation, (2) explores occupational and technical fields and their educational requirements, and that (3) comes early enough in the students program so that he is able to coordinate course schedules to meet the requirements of selected orientation.

The following includes a tentative list of topics which are probable areas of consideration during the course with the specific objective of relating them to occupation and other fields of study that require technical knowledge of these areas.

I. Field Trip Subjects

A. Agriculture - agronomic aspects of farm drainage and irrigation systems; fertility management; land use (i.e. soils and their capability in relation to crop growth, construction, and conservation requirements).

B. Government — (MAC, IAN, PRIDA, MOP, etc) — technical aspects of land use in watershed problems, conservation, agricultural VS urban planning, and soil survey. The economic, political, and psychological considerations most frequently encountered in this occupational area.

C. Private and other interests — (FUDECO, CORPOCCIDENTE, MIN. DE FOMENTO, etc) — aspects of development, zoning regulations, planning boards, contractors, etc who require or have need of agronomic perspective in dealing with their projects.

II. Lecture-Discussion Sections

A. Topic lecturers-professors in associated fields to stimulate interest in specific courses related to agronomic occupations. Representatives of technical occupations, as well as administrative and research personnel.

B. Class discussions (possible organization) - panel-led discussions on particular topic in which students are allowed the choice of doing more intensive research; follow-up discussion on previous lecture—especially to relate to areas seen on field trip; and group participation in solving a particular agronomic problem with consideration of social and economic factors that would affect the feasibility of a particular solution.

Soil Science — Intermediate Level Courses

Soil is such a basic component in understanding our environment and in producing a desired quality of environment that soil scientists must better understand all aspects of the discipline. An undergraduate in a Soil Science orientation should obtain more in-depth training in soil biology, soil chemistry, soil physics, pedology, and soil management than is available in an introductory course. To be able to map soils but not understand permeability or the properties of soil clays is not satisfactory. Whether formalized academic training ends or continues after five years is almost immaterial — a young lopsided soil scientist does not seem to be a desire nor a need of our society.

The subject matter should build on the foundation of the introductory course by briefly reviewing specific items, and concentrate on providing some in-depth scope to the area of concern.

As a starting point there are 20 hours of lecture per subject area, and labs or discussions are flexible.

The increasing concern of society in general about the state of the world is reflected in the offering of intermediate level courses about nonfarm uses of soil, and the role of Soil Science in environmental quality. Students are not as conscious of the interaction of Soil Science with society as they are aware of the sociological needs of mankind; they are not aware of the many possibilities to make a positive contribution.

The proposed semester courses include:

A. The Soil System I: Soil chemistry and soil biology. 4 credits. A lecture-lab course dealing with soil as a biological and chemical system including the role of clay minerals.

B. The Soil System II: Soil physics and pedology. 4 credits. A lecture-lab course dealing with soil as a natural body; recognition and understanding of soil as a physical entity.

C. Agricultural Soil Management. 4 or 5 credits. A lecture-discussion-lab course dealing with the inputs to obtain desired responses including the control of water regimes, erosion, weed and pest control, and balance of nutrients for sustained agricultural production.

D. Non-agricultural Uses of Soil. 2 or 3 credits. A lecture-discussion course dealing with society's needs and uses of soil resources in a non-agricultural sense.

E. Application of Agronomia. 3 credits. A week's field trip in the Centro Occidental Region followed by lecture-discussion course dealing with the relation of soil science or better Agronomia and other fields to agriculture. Intent is to come early in student's program (after Intro. Soils and an Introductory Crops Course).

F. Soil, the Ecosystem, and Society. 1 or 2 credits. A seminar-discussion course for advanced undergraduated dealing with other areas in which soil science has an input; also considering potential and economic aspects.

The Soil System I. Soil Chemistry and Biology

(4 credits)

Objective: To provide in-depth training at an intermediate level in the chemistry and biology of soil, relating both subject areas to the functioning of soil as a natural medium for plant growth.

Student Needs: Beyond the introduction of these areas it is thought that students need (a) to understand and determine the common chemical and biological properties of soil; (b) to understand the chemical and biological processes occurring in soil; and (c) to understand how the chemistry and biology of the soil influence soil productivity.

As a semester course it would have about 20 hours of lecture in each subject area with labs.

To meet the above needs the following subject matter is thought to be important.

Chemistry

1. Chemistry of development and regulation of neutral, alkaline and acid soils, and the chemical processes occurring in soil under these conditions.
2. Composition and properties of clay minerals and organic matter.
3. Chemical methods of soil analysis; how and why measurements are made.

Biology

1. The nature, distribution and ecology of soil organisms.
2. The role of soil organisms as agents of transformation, competition and disease.
3. Interrelationships between microbial species and between microorganisms and plants.

The soil system II. Soil physics and pedology

(4 credits)

Objective: To provide in-depth training at an intermediate level in the concepts and functioning of soil as a natural entity with emphasis on physical aspects of the soil system.

Student Needs: Beyond the introduction of these areas it is thought that students need: (a) to understand concepts of soil development and their relationship to classification and survey; (b) to understand and determine the common physical properties of soils; and (c) to be able to interpret soil facts in a meaningful way.

As a semester course it would have about 20 hours of lecture in each subject matter area with labs or demonstrations mainly concentrating on soil as a natural physical system. Field trips and some labs to acquaint students with concepts and techniques of pedology.

Pedology: To meet the above needs the following subject matter is thought to be important.

1. Concepts of soil development, its morphological expression, and methods of recognition, including emphasis on geomorphic processes.

2. The current classification system and its relation to soil survey and interpretation. Enough depth to be able tu use the system, at least locally.

3. Soil homogeneity and variability — the implications and how to apply them.

Soil Physics. To meet the above needs the following subject matter is thought to be important:

1. Composition and distribution of physical components, and how they can be measured and understood.

2. Properties resulting from horizon differentiation, their measurement and interpretation.

3. Methods of changing physical properties or environment to produce desired results with emphasis on understanding how and why modifications may be made.

Non-Agricultural Soil Management

(3 credits)

Objective: To provide training at an intermediate level in the application of soils information to non-agricultural uses.

Student Needs: While in the past, agriculture has been the principal exploiter of our rural lands, there is now an increasing interest in the use of soils for non-agricultural uses. It is thought that the student needs to understand these uses and be able to supply relevant soil interpretations to these users.

As a semester course it would have about 20 hours of lecture. Guest lecturers related to specific non-agricultural uses would utilize the remaining 10 lecture hours. Discussion sessions would follow guest lecturers whereby the student could apply soils information to the specific field represented. Field trips would be used to point out correct non-agricultural uses.

To meet the above needs, the following subject matter is thought to be important:

1. Identification of the non-agricultural users and uses.

2. The concepts and points of view of these users.

3. Engineering index parameters of soils.

4. Kinds and uses of suitability criteria.

Agricultural Soil Management
(4 credits)

Objectives: To provide in-dept training at an intermediate level in concepts of agricultural soil management directed toward increased crop production through conservation, fertilization and other control procedures.

Student Needs: It is thought that students need to understand (a) the nature and significance of the moisture regime of soils and the various methods used to control this regime; (b) the nutrient requirements for sustaining and increasing production and the parameters associated with maintaining this production through fertilization; (c) the principles and practices of soil conservation; and (d) the principles of weed and pest control as they interact with other aspects to produce desired results.

As a semester course it would have about 40 hours of lecture with labs and demonstration directed toward management problems. Field trips would be used to demonstrate management practices in operation in the immediate area.

To meet the above needs, the following subject matter is thought to be important in presenting an integrated view of soil management for agriculture.

1. Concepts of irrigation and drainage appropriate for soils in the region.

2. Concepts of fertilization with emphasis on nutrient requirements, interaction, and nutrient cycles.

3. Soil and water conservation as it relates to increased production and decreased pollution.

4. The various classification systems developed to organize the existing knowledge of agricultural soil management.

5. Methods of weed and pest control with some emphasis on mobility and pollution potential.

Soil, the Ecosystem and Society

(2 credits)

Objective: It is believed there is a need for a course to examine areas in which Soil Science is involved in research and in specific problems of contemporary society.

Student Needs: Upon completion of a coordinate schedule of courses at the introductory and intermediate levels, a higher level course such as this would: (1) relate technical information derived from previous courses to contemporary agricultural and economic problems and their interactions with society; (2) provide insight as to what future courses a student may require to successfully pursue a post-graduate field of work; (3) specifically relate this orientation to related fields of study and to the society of the future.

The following includes some areas which possibly would be considered to meet the objective of the course.

A. Pollution - the role of soil in the use of pesticides and fertilizers, waste disposal, relevant factors of soil chemistry and biology. Examination of political and economic factors involved in contemporary pollution problems.

B. Engineering - Flood control and irrigation projects, structural designs as related to soil characteristics, soil mapping techniques.

C. Crop Production - advising of most profitable cropping sequence, fertility practices as dictated by soil characteristics, economic considerations.

D. Conservation - soil properties in planing terraces, irrigation projects, park, and recreational facilities. Government projects VS privately-controled projects.

E. Controlling of Land Use - agricultural use of soils VS. the urban society-can zoning be effective. How are, or should soils be evaluated for taxation purposes?

Comments: To create the greatest possibility for attendance of speakers outside the University, it was felt that lecture sections would be most appropriately scheduled in the evening. This would gain the added advantage of allowing speakers to have sufficient time to cover their respective topics and allow for student question. Discussion sections, however, could be scheduled during regular class hours.

Special Topics

(1 or 2 credits)

Objective: To permit students to explore subjects in greater depth, or to examine new areas of interest mainly by independent study but with guidance of a staff member.

Special topics may serve to increase or enhance a particular orientation or enable a student to become acquainted with some discipline or subject area that was not scheduled in his selected orientation.

Completion of a topic may involve review of pertinent literature, field experiments, laboratory research, or other activities appropriate to the objectives of the student. Usually it involves writing a scientific-type paper summarizing the results of the study.

It is proposed that a student take at least one Special Topic in his fourth year (7º or 8º), and another in his fifth year (9º or 10º). Credit may be 1 or 2 depending on time available and nature of the project.

For example, in Pedology a student may wish to become more familiar with soil mapping in the field, or to know more about the logic and use of classification schemes, or wish to do some simple research projects, or to develop teaching materials related to a particular course. Often interest in post-graduate work develops because of the experience and guidance provided by these Special Topics.

RWA/ldoh