SOUTHEAST REGIONAL
COLLEGIATE SOILS CONTEST

OFFICIAL HANDBOOK

HANDBOOK FOR COLLEGIATE SOILS CONTEST

Southeastern Region

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Southeast Region Web Site: http://clic.cses.vt.edu/SE_Region_Soil_Judging/

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INTRODUCTION

Collegiate soil judging had its beginning in the Southeastern Region in 1956. It is sponsored by the Students of Agronomy, Soils, and Environmental Sciences (SASES), which is an undergraduate student organization of the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA). Any college or university that provides a four year curriculum in agriculture located in Alabama, Florida, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia, West Virginia, or Puerto Rico is eligible to compete in the Southeastern Regional Collegiate Soils Contest provided it has a sponsoring curriculum club which is an active member of SASES. The first Southeastern regional contest was held at Tennessee Technological University. The location of the contests held over the past few years and the rotation agreed upon for the next few years is given below to assist in determining the location of future contests.

1988 University of Georgia
1989 Clemson University
1990 Murray State University (Regional and National)
1991 Auburn University
1992 University of Tennessee-Martin
1993 North Carolina State University
1994 West Virginia University
1995 Virginia Polytechnic Institute and State University
1996 University of Florida
1997 University of Georgia (Regional and National)
1998 University of Tennessee-Knoxville
1999 University of Kentucky
2000 Tennessee Tech University
2001 Murray State University
2002 Clemson University
2003 University of Tennessee-Martin
2004 Auburn University (Regional and National)

2005 North Carolina State University
2006 Western Kentucky University
2007 Eastern Kentucky University
2008 Virginia Tech
2009 University of Tennessee-Knoxville
2010 University of Georgia
2011 West Virginia University (Regional and National)
2012 University of Kentucky
2013 Tennessee Tech University
2014 Clemson University
2015 Murray State University
2016 Auburn University
2017 University of Tennessee-Martin
2018 North Carolina State University (Regional and National)

The location of the contest in the region shall be on a mutually agreed-upon rotational basis. The time of the contest will be selected by the host school, but it is usually during one of the last two weeks in October. Events that normally occur during the week of the contest include:

(1) registration,
(2) practice time,
(3) a meeting between the coaches and the official judge(s),
(4) a dinner with optional educational presentation,
(5) a coach's business meeting,
(6) the contest, and
(7) an awards ceremony.

The activities normally start on a Tuesday morning with registration and end on a Friday afternoon with an awards ceremony. Tuesday through Thursday are used to show practice sites. The practice sites may be pits or other soil exposures. The competition is on Friday morning.

GENERAL RULES OF THE SOUTHEAST REGION

Eligibility

Any college or university that provides a curriculum in agriculture, soils, geosciences, and/or environmental science may enter a team in the Southeast Regional Collegiate Soils Contest if it has an interest in the contest. To compete in the Southeast Region, the college or university must be affiliated with the Students of Agronomy, Soils, and Environmental Sciences (SASES). SASES is an undergraduate student organization of the American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA). The host school will not officially field a team but is counted as a competing school. A team is composed of three or four undergraduate students who are enrolled full-time in a four-year curriculum and have not completed a bachelor's degree in a related discipline. In addition, each student must be eligible to represent their institution according to the eligibility rules of that institution. A team member may participate in the regional contest for as many years as he or she is eligible under the above rules.

Within the Southeastern Region, only one official team may represent any university in the regional contest; however, four additional students may participate in the contest (eight students maximum). The official team members shall be named prior to the start of the contest and only this team is eligible to compete for the team trophy. The additional students are eligible to receive the individual trophies. Students from the host school are allowed to use the contest for training purposes but should rotate through the pits at times other than during the contest.

The equipment that may be used by each contestant include: Munsell soil color charts (written guides included in color books must be removed), knife or other handheld digging tool, Abney level or clinometer, dilute hydrochloric acid, 2-mm sieve, and a 10x hand lens. Allowable electronic devices include: a simple watch, clock, or calculator, or a pre-approved device needed for health or safety reasons (e.g., hearing aide). Use of any unapproved device that can be used for communication will result in immediate disqualification for all students who have been seen using the device.

Time Limits

A period of 50 minutes is allowed for judging each contest pit. For the first five minutes, subgroup I is allowed in the pit, while subgroup O is judging other site characteristics. Subgroup O is allowed to reach into the pit to grab a sample of the A horizon on the pit side opposite the no-pick zones but must not speak to or signal any teammates. For the next five minutes, the subgroups trade positions. This is followed by allowing subgroup I back into the pit for 10 minutes. During the next 10 minutes, subgroup O is allowed in the pit. During the last 20 minutes, anyone is allowed in the pit, as long as two members from the same institution are not in the same pit on the same side at the same time.

Site and Rotation Procedures

Four judging sites constitute a contest. Each site will consist of a land area bounded by suitable markers and, within this area, a pit of approximately 10 feet long, four feet deep and four feet wide to expose the soil profile. The pit should be of sufficient width to allow at least six persons to judge simultaneously at each "no-pick" zone, a vertical portion of the profile 40-50 cm wide marked on the edges with tape or ribbon and with a permanently-fixed depth marker between. Two no-pick zones should be widely-spaced on the left and right side of the same pit wall facing the morning sun. Both left and right no-pick zones in the same pit should have the same number of horizons and the same number of recognized parent materials and diagnostic horizons/features. Soil properties or features in contest pits to be ignored by the students should be covered by the host with black plastic.

On the morning of the contest, each contestant will be given a packet containing four scorecards, each of a different color, and the following handouts: the runoff table, the erosion table, the soil interpretation tables, a soil texture triangle, and an official abbreviation sheet (http://clic.cses.vt.edu/SE_Region_Soil_Judging/Abbreviations_handouts.pdf). The handouts should have a watermark to authenticate them as those handed out by the official host. No other written guides are allowed.

Scorecard Labeling

The SE Regional Soil Judging web site provides a spreadsheet that shows how the scorecard labeling is to be done. It is called "scorecard_labels.xls". This is a master list; not all labels will be used. The site also includes a Microsoft® Word™ template called "labels.doc" for printing scorecard labels, and a template for printing tie-breaker labels on Avery® Labels 1560 called "tiebreaker_labels.doc".

The label sets were created so that the starting pit is staggered so that no more than two students from the same school start at the same contest site. If two students from the same school are at the same contest site; they are not to be in a judging pit at the same time and are not to describe the same no-pick zone. Each contestant is assigned to start in the pit first at two pits and start out of the pit first at two pits. Each contestant is assigned to describe on the left side at two pits and on the right side at two pits.

Scoring

The official judges will mark the definitive answers on all scorecards. In Part A, the judges may list equally acceptable answers that receive full credit in parentheses below the definitive answer. Alternate answers in Part A are not to be used to determine correct answers within any other part of the scorecard. If lab data is very close to a textural class boundary, alternative acceptable textures are listed in parentheses. Alternative acceptable answers for texture include a range of (±4%) for clay and (±4%) for sand percentage on contest grading scorecards, but are determined by the official judges for practice pit scorecards.

When multiple correct answers are listed for parent materials in Part C, points are awarded for each correct answer, but points are deducted for each incorrect or additional (excessive) answer. The minimum score for parent materials is zero. The maximum points for parent material is determined by the number of recognized parent materials, with each correct answer worth 5 points. For example, if two parent materials should be marked, each correct answer is worth 5 points and the total for parent materials is 10 points. This same approach is used for determining point totals for diagnostic subsurface horizons and features in Part D, with each correct answer worth 5 points, but the minimum score being zero.

Points for each answer are indicated on the scorecard. All boxes left blank in Part A are incorrect answers. The allowable error range for horizon boundary depths (discussed later) and clay percentages (±4%) are to be listed in parentheses on the scorecards used for grading. Scores should be double-checked down each column in Part A and in Parts B, C, and D by separate graders, who initial their work. The total scores by student by pit should be double-checked for entry errors in the scoring spreadsheet. The total scores of all four contest pits are used to determine an individual's score. The total scores of a team's three highest scoring contestants at each contest pit are used to determine the team's score. A scoring spreadsheet is provided for use in tabulating the individual and team scores, and is posted on the web site: http://clic.cses.vt.edu/ SE_Region_Soil_Judging/scoring.xls.

Particle size analysis shall be used by the host school to determine the correct percentages of the sand, silt, and clay on all contest pit soil horizons. Contestants will estimate the percentages of sand, silt, and clay of a sample taken from a horizon at the pit with the fewest horizons, placed in a container by the host. If two or more students tie with the same total score, ties are broken by awarding the higher finish to the student with the closest estimate of clay, then sand (if needed), and then silt (if needed) compared to the particle-size results. If there is still a tie, the clay estimates are summed for all horizons in that pit and the grand totals compared to the particle-size results grand total. The student with the closest grand total finishes in a higher place. If two or more teams tie with the same total score, the winner will be the closest average clay estimate on the tiebreaker sample. The average is determined by dividing the sum of the tiebreaker clay estimates by the number of A-D students on each team. If there is still a tie, the sand estimates are compared in a similar manner.

The contest results shall be announced by the host institution as soon as possible after the contest. The results will be final. The return of the score cards to the contestants after the contest is up to the discretion of the host school. However, after the contest the host school should provide copies of the official contest pit descriptions, and a hard copy of the scoring matrix handed out. The host school shall also provide suitable plaques or trophies for the highest scoring teams that qualify for the national contest and at least the five highest scoring individuals.

Duties of the Competing Schools

As early as possible, the competing schools should provide an estimate of the number of students and coaches that they will be bringing to the contest. The schools should notify the host of any medical needs, access or mobility issues, special dietary needs, or medicine needed to be taken during the contest. At registration, the schools may be asked to provide a registration fee in cash or check, along with contact information (lodging location, cell phone numbers) and two copies of a list of student names (printed carefully), using the form provided at http://clic.cses.vt.edu/SE_Region_Soil_Judging/team_list.doc. On Thursday evening before the contest, the four representative students should be identified with letters A through D and four alternates need to be identified by checkmark on the registration form. The coach should make the same designations on their copy to use for handing out the scorecards to the correct students. Any changes after that list must be made clear to a contest official before the students leave the staging area and should be for unexpected circumstances such as serious medical or family emergency only. Coaches must explain the relation of colors to pit numbers, writing the correct pit number and side described on the cards, the rules for left and right side description, and the in and out procedure. Students should be sure to start at the correct pit according to their letter, write the pit number and side (e.g., 2-L) on their card, and describe the correct side of the pit as indicated by the label on their card. Students may put their name on the scorecard if the scorecards are double graded.

Duties of the Contest Host

The upcoming contest host is asked to provide the date of the upcoming contest to the competing schools as early as possible, preferably at the coach’s business meeting. The host is asked to suggest local lodging and possibly arrange special pricing. The host school will prepare appropriate contest sites and arrange for neutral, official judges to score the sites. The practice sites will be judged by the same official judges, and their scoring will be provided to the coaches prior to the practice judging. Practice sites should have a no-pick zone designated by two vertical ribbons similar to the contest pits, with a nail in the third horizon at a specific depth, and the pit face should be large enough to allow access and viewing by four to eight students.

Practice sites will be available on Tuesday, Wednesday, and Thursday of the contest week. If there is an off-limits area, it is to be identified by the host at registration. Violations of digging in or driving through the off-limits area may result in disqualification of the school by the host. Maps to the practice sites will be provided at registration, along with any lab or site information. It is recommended that coaches of participating schools cooperate with each other at the practice sites for maximum time efficiency, and that the host facilitate exchange of cell phone numbers between the official judges and one coach per school for notification of important changes. Sometime before the contest at least one of the official judges should be available to answer questions pertaining to soil judging policies and regulations followed. This usually is done both at the practice sites and at the coach-judge meeting. It is recommended that only coaches (not students) attend the meeting scheduled in the evening two nights before the contest. The night before the contest, it is customary to have a hosted dinner and an optional presentation. At that time, the registration sheets should be handed back to the coaches who will check spelling of names and assign letters to their representative students, and place a checkmark next to four alternates. The host will assign letters to the alternates, then hand a copy of the registration list back to the coaches for final verification on the morning of the contest. This is the copy used to hand out cards by the coaches.

Prior to judging, the schools are assigned a number, and that number recorded in the scoring spreadsheet and on the team registration form. Up to eight contestants from that school are assigned a letter. Letters A-D will be used for the representative team members, and letters E-H will be used for additional students designated by their coaches with checkmarks. The additional students should be equally divided between pits. This can be done by printing all labels, then sorting the team lists by the number of additional judgers. Pull selected labels from the labels printed earlier to make sets of letters E-H. For example:

Pit data cards and waterproof paper scorecards should be color coded to match, using four distinct light colors such orange, blue, yellow, and green. Paper source information can be passed down from the previous contest host.

If teams 5 and 6 bring one extra judger, teams 7 and 8 bring two extra judgers, teams 9 and 10 bring three extra judgers, and teams 11 and 12 bring four extra judgers.

(1) Take the teams with four additional students (teams 11 and 12) and assign labels: E, F, G, and H for their team number.

(2) Match the teams with one additional student (teams 5 and 6) with the teams with three additional students (teams 9 and 10) to make out groups of four. Assign the single additional students from the team 5 and 6 as letter E, and the additional students from teams 9 and 10 with letters F, G, and H.

(3) Match the teams two extra students each (teams 7 and 8) to make sets with labels E, F, G, and H.

(4) There may be more teams with additional unmatched students. Take all mismatched students and distribute them as equally as possible between letters E, F, G, and H.

The morning of the contest, the official scorecards and handouts are given out to the coach of each team, who should then distribute them to the students just before loading and traveling to the contest sites. Each student should have one card of each color. Two cards should be marked with R for “right”, and two with L for “left”. Two should be marked with I for “in”, and two with O for “out.” Students A and E should start in pit 1, then go to pit 2, 3, and then 4. Students B and F should start in pit 2, then go to pit 3, 4, and then 1. Students C and G should start in pit 3, then go to pit 4, 1, and then 2. Students D and H should start in pit 4, then go to pit 1, 2, and then 3. The host should staple the cards in proper sequence before handing them out. If this is not done, the host must verbally review the order and color of the starting pit for each letter again just before the contest begins.

At the contest site, students should be gathered at their starting pit before the contest begins. The host should provide a printed list of duties to pit monitors before the contest, and review their duties. The host notifies the coaches of the time they are allowed to travel to the contest site. A map or directions should be provided to the coaches after the contest begins. The host should provide the pit monitor at pit 1 with an air horn if all contest pits are in close proximity. If not, watches should be standardized and starting times should be uniform.

Four judging sites constitute a contest. Each site will consist of a land area bounded by suitable markers and, within this area, a pit of approximately 15 feet (4.5 m) long, four to five feet deep (100-130 cm) and three feet (90 cm) or more wide on each side of each no-pick zone for sample collection, with a one-foot (30 cm) buffer between sample collection areas of the left and right side. Two no-pick zones should be widely-spaced on the left and right side of the same pit wall facing the sun. The pit should be of sufficient width to allow at least six persons to judge simultaneously at each no-pick zone, three on each side. The pits should have a sloping ramp for access, and the pit should be dug and exposed 10-cm deeper than the maximum depth to be described across the sampling and no-pick zone. Distracting features to be ignored (such as a prior-disturbed area) should be covered by the host. The host will place a nail in the third horizon of each no-pick zone.

Information provided at practice and contest sites includes the site number, the maximum depth to be described, the depth to the nail in the third horizon, the number of horizons to be described, and, if necessary, flooding or ponding frequency. If no information is provided on flooding or ponding, it should be inferred that none occurs. Lab data, as needed, will be supplied by the host for every horizon at each site. This commonly includes estimated or measured organic carbon percent and base saturation percent by NH_4OAc or by sum of the bases (Ca, Mg, K, and Na). Dry colors, CEC cmol(+)/kg clay, and other chemical data are provided if appropriate. Texture data should be provided in a consistent manner between practice and contest pits. Particle-size analysis should be measured on contest pit horizons if possible, and practice pit textures either measured or estimated and adjusted based on the measured particle-size results. If it is not possible to run particle-size analysis on contest pits, the contest pit textures should be estimated by the official judges. In either case, the host should notify the coaches which procedure was followed.

The host school must provide one Abney level (or one clinometer), extra water and one portable container, one dropper bottle of hydrochloric acid (if needed), and one color book at each contest pit.

A loud sound such as a horn is used to notify all pit monitors to uniformly begin the 50-minute pit judging rotations. Adequate time is suggested for travel between pits. If possible, the host should provide two portable toilets at the contest judging area.

The host is required to take or collect pictures of the top three placing teams and send the pictures and student names to CSA News, 5585 Guilford Road, Madison, WI 53711-5801 or https://www.soils.org/publications/csa-news/ as soon as possible after the contest. A picture and/or list of the top 10 individuals should also be sent.

Duties of the Official Judges

The official judges are to describe and evaluate each site according to the general guidelines set forth in this handbook. A scorecard for each practice site and for all contest pits is provided to the official host, complete with their preferred answers, and any alternate acceptable answers listed below. Both left and right no-pick zones in the same pit should have the same number of horizons. Judges are discouraged from selecting no-pick zone locations within the pit where horizon boundaries fall precisely on limits that are used in determining answers in other sections of the scorecard. For example, a horizon boundary at the top of a root-limiting contact should not fall on a breakpoint that causes two alternative answers in the interpretations section to be equally correct. The same is true of selecting slope stake locations that result in slope angles that fall extremely close to slope class breakpoints. The judges are asked to place slope stakes near the pit on a slope gradient that represents the slope and the landform position on which the soil pit is located. An official judge and the contest host are to be present and available during the week to answer questions.

Duties of the Pit Monitors

Monitors should announce starting and rotation times uniformly following the example below. A few minutes before starting, announce: “We will begin in a few minutes when the horn sounds or when I tell you to begin. This is pit ___. Be sure to use the ______ colored card. You should mark the pit and the side that you will describe in the upper left-hand corner, matching the label on the card. Do not disturb the soil in the no-pick zone. When time ends, you must put down your pencils. Any marks made after that will result in disqualification at this pit. Scorecards are never returned to a contestant once turned in to the pit monitor. Only the students with the letter I on their contestant number should enter the pit in the first time period. Any student may reach into the pit to gather a sample of the top horizon only, but not above where any other student is standing in the pit. Written guides included in Munsell color books must be removed. No written materials can be in your possession during the contest other than those handed out by the contest host."

8:00 AM – "Only the I student group may enter for 5 minutes."

8:03 AM – "Two minutes left before the I student group must exit."

8:05 AM – "Change groups. Only the O student group may enter for 5 minutes."

8:08 AM – "Two minutes left before the letter O student group must exit."

8:10 AM – "Change groups. Only the I student group may enter for 10 minutes."

8:18 AM – "Two minutes left before the I student group must exit."

8:20 AM – "Change groups. Only the O student group may enter for 10 minutes."

8:28 AM – "Two minutes left before the O student group must exit."

8:30 AM – "Free-for-all period begins. Any student may enter for 20 minutes."

8:48 AM – "Two minutes left."

8:50 AM – "STOP. Put your pencils down. Turn in your cards immediately and go to the next pit (give directions). The next pit judging starts in 10 minutes."

The pit monitor for pit 1 may be asked to sound an air horn to start each rotation. Pit monitors should accept scorecards between the start and end of the 50 minutes, but scorecards handed in after the end of 50 minutes should be marked as "LATE" across the face. If a line forms for turning in scorecards at the very end of the time limit, monitors are to make sure the contestants have put their pencils down and are not marking on the cards.

The pit monitor should have a shovel available to clean out the spoil from in front of the no-pick zone (at least 10 cm below the maximum depth to be described) between rotations and whenever the lowest depth to be described is covered by spoil. Monitors should not allow contestants to pick in the no-pick zone. Contestants may not touch the tape or ruler but they may ask the pit monitor to attach extra nails if the tape is blowing in the breeze and unreadable. Contestants may spray water lightly on a dry pit surface.

Altering or deforming the no-pick zone by excess spraying is prohibited. Deep excavation from the sides and behind the no-pick zone is prohibited.

Monitors should check the tape or ruler between each rotation to be sure the depth to the nail in the third horizon has not changed. If a student notices that the depth of the nail in the third horizon does not match the depth given on the posted contest pit information during the rotation, the monitor should announce the discrepancy as soon as possible. It is recommended that students double-check their depths before turning in their scorecards. Monitors should have the ability to contact the contest host rapidly by phone in case emergencies or questions arise.

Talking will not be permitted, except with the pit monitor, during the 50-minute period while judging is taking place. If the pit supervisor observes a violation of this rule, or any other form of cheating, they should immediately collect the scorecard of the individual or individuals involved and record a zero for that pit. The contestants may write notes from memory on their handouts after leaving the presence of their coach and teammates and after discarding all notes and printed materials except the handouts. Observed use of communication devices or examination of guides or notes not written on the sheets handed out the morning of the contest is considered cheating.

At the discretion of the host, coaches may be permitted in the area of the pits during the contest. Coaches will be permitted to examine the pits after the contest. No communications between team members or with the coach(es) is permitted while the contest is underway.

SCORECARD SECTIONS

The scorecard consists of four sections: A. Morphology; B. Soil Properties and Interpretations; C. Site Characteristics; and D. Soil Classification.

Part A. Morphology

When entering answers on the morphology section of the scorecard, standard abbreviations should be used. A table is included in the Appendix of this Handbook that contains standard abbreviations for all scorecard entries.

Horizons

Number of Horizons

A soil horizon is a layer of soil approximately parallel to the soil surface differing from adjacent genetically related layers in characteristics such as color, texture, structure and consistence. The official judges will state the number of horizons and the maximum depth to be described. Each horizon to be described must have its upper boundary above the maximum depth of description. Description and interpretation begins where the zero depth measurement on the official measuring tape is placed. O horizons, if present, are not described.

Minimum Horizon Thickness

Narrow transitional horizons <10 cm thick are not described, but are regarded as a gradual lower boundary for the horizon above. The center of the narrow horizon is used as the lower horizon depth for the horizon above it. For all other cases, the lower horizon boundary is used as the lower horizon depth. The lower depth of the lowermost horizon is provided by the judges. Horizons that can be thinner than 10 cm but should be described if at least 5 cm thick are A, E, Bh, Bhs, Bs, and B horizons with subordinate letter m. All other horizons and layers must be 10 cm or more thick to be described, including Cr and R horizons. If horizons with lamellae are present (E & Bt or Bt & E), the thickest individual subhorizon of the E or Bt component (NOT the cumulative thickness of all component subhorizons) must be 5 cm or more thick, and the properties of that thickest subhorizon are to be described in Section A.

Horizon Symbols

The appropriate horizon designations, complete with subordinate distinctions, should be entered on the scorecard, in the following sequence: name the master horizons, then add transitional and combination horizons, subordinate letters, suffix numerals, primes, and then prefixes for discontinuities as needed. The official judges may give partial credit for incorrect answers in cases where the horizons are difficult to differentiate.

Master Horizons

A horizons. Mineral horizons that formed at the surface and (1) are characterized by an accumulation of humified organic matter intimately mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons (defined below), or (2) have properties resulting from cultivation, pasturing, or similar kinds of disturbance.

E horizons. Mineral horizons in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these, leaving a concentration of sand and silt particles of quartz or other resistant minerals. An E horizon is usually, but not necessarily, lighter in color than an underlying B horizon. An E horizon is most commonly differentiated from an overlying A horizon by lighter color and generally has measurably less organic matter than the A horizon. An E horizon most commonly has color of higher value or lower chroma, coarser texture, or a combination of these properties compared to the underlying B horizon in the same profile.

B horizons. Horizons formed below an A or E horizon and dominated by obliteration of more than half of the original rock structure and by (1) illuvial concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, sodium, sufates, soluble salts, or silica, alone or in combination; (2) evidence of removal of carbonates; (3) residuual concentration of sesquioxides or other iron-oxides; (4) coatings of sesquioxides that make the horizon conspicuously lower in value, higher in chroma, or redder in hue than overlying and underlying horizons without apparent illuviation of iron; (5) alteration (synthesis of silicate clay or liberation of oxides or both) that forms granular, blocky, or prismatic structure if volume changes accompany changes in moisture content; (6) brittleness; or (7) strong gleying.

C horizons. Horizons or layers, excluding strongly-cemented bedrock (R layers), that are little affected by pedogenic processes and lack properties of A, E, or B horizons. C horizons may be composed of unconsolidated materials, noncemented bedrock (saprolite), or weakly to moderately cemented bedrock (paralithic materials). The material of C horizons or layers may be either like or unlike that from which the solum presumably formed. Many C horizons or layers are structureless. Other C horizons or layers may have 50% or more rock-controlled structure or the structure formed by thin stratification of alternating layers of different textures (non-pedogenic structure). They may not have structure resulting from soil-forming processes (pedogenic soil structure) in more than 50% of the volume. C horizons or layers may have been very slightly modified through initial pedogenesis, as when bedrock weathers and loses some cementation agent, or when scattered redoximorphic features form in parent material, widely-spaced cracks develop following dessication, or carbonates or clays are deposited along existing cracks between bedrock fragments. If pedogenesis is easily observed, the horizon is transitional to a B horizon above.

R Layers (Strongly-cemented hard bedrock). Granite, quartzite, limestone, and strongly cemented sandstones are examples of bedrock that may be designated R. Fragments are strongly cemented (may not be cut with a spade or knife, snapped apart by hand, or crushed under a boot). An R layer is sufficiently coherent to make hand digging of a pit through the layer with a pick and spade impractical, although fragments may be chipped or scraped with a spade. Some R layers can be only be excavated with heavy power equipment. The bedrock may contain cracks, but for the purposes of this contest we will assume that these layers qualify as lithic materials, which means that cracks are few and narrow enough that fine roots cannot penetrate the layer more closely spaced than 10 cm on average.

Transitional Horizons

Transitional horizons have properties that are intermediate in expression between two master horizons that are present or are presumed to have been present in the described soil profile. Two capital letter symbols are used, as AB, EB, BE, BC. The master horizon symbol that is given first designates the kind of horizon whose properties dominate the transitional horizon. An AB horizon, for example, has characteristics of both an overlying A horizon and an underlying B horizon, but is more like the A than the B.

In some cases, a horizon can be designated as transitional even if one of the master horizons to which it is apparently transitional is not present. A BE horizon may be recognized in a truncated soil if its properties are similar to those of a BE horizon in a soil in which the overlying E horizon has not been removed by erosion. An AB or BA horizon may be recognized where bedrock underlies the transitional horizon. A BC horizon may be recognized even if no underlying C horizon is present; it is transitional to assumed parent material.

Combination Horizons

Combination horizons have properties of two distinctly different master horizons in discrete parts of the same horizon. The distinct parts are segregated enough that they may be sampled and described separately. The two master horizon letters are separated by a virgule (/) if the parts are side by side, such as E/B or B/E. The two master horizon letters are separated by an ampersand (&) if the parts are layered horizontally, such as when lamellae are identified. In such a case, E & B, B & C, etc. may be used to identify the lamellae and alternating horizon materials. The horizontal layering of master horizons is thought to be pedogenic development rather than by geologic stratification.

The master horizon materials that dominate the volume of the horizon are listed first. The master horizon materials that make up the majority of the volume of the combination horizon should be sampled and described, rather than a mixture of the two distinct materials.

Subordinate Distinctions

b, Buried genetic horizon. This symbol is used in mineral soils to indicate identifiable buried genetic horizons if the major features of the buried horizon had been established before it was buried. Other genetic horizons may or may not be present in the overlying material.

c, Concretions or nodules. This symbol is used to indicate a significant accumulation of concretions (masses with concentric rings) or nodules (nonconcentric masses) cemented by material other than silica. This symbol is not used if concretions or nodules are dolomite or calcite or more soluble salts, but it is used if the nodules or concretions are enriched in iron, aluminum, manganese, or titanium. This symbol is not used for plinthite.

d, Physical root restriction. This symbol indicates dense (high bulk density), root-restricting layers that are not cemented in naturally occurring or human-made sediments or materials. Cracks or structural surfaces are few and narrow enough that fine roots cannot penetrate the layer more closely spaced than 10 cm on average. Examples are dense basal till, plowpans, and other mechanically compacted zones.

g, Strong gleying. This symbol is used to indicate either that iron and manganese have been reduced and removed during soil formation or that saturation with stagnant water has preserved a reduced state. Redoximorphic features (defined later), such as redox contentrations, redox depletions, and depleted matrix, are used to determine the presence of strong gleying. Affected layers in the subsoil have a matrix color of high value (≥4) and low chroma (≤2) and many contain redoximorphic concentrations and/or depletions. A low chroma is generally the color of mineral particles from which iron and manganese have been removed. However, the symbol g is not used for soil materials of low chroma such as bedrock or E horizons unless they contain soft masses or pore linings of precipitated Fe or Mn oxides (redoximorphic concentrations, defined later). For horizons with an accumulation of humified organic matter, such as A horizons, the symbol g may be used if (i) the matrix chroma is 2 or less, ≤2, (ii) distinct redoximorphic depletions or redoximorphic concentrations as soft masses or pore linings are present in the A horizon, and (iii) redoximorphic depletions or a depleted matrix due to prolonged saturation and reduction are observed in the horizon directly below the A horizon. If g is used with B, pedogenic change (i.e., the formation of structure units) in addition to strong gleying is implied. If no pedogenic change has taken place, the horizon is designated Cg.

h, Illuvial accumulation of organo-sesquioxide complexes. This symbol is used with B to indicate the accumulation of illuvial organic compounds bonded to sesquioxides (organic compound-sesquioxide complexes) if the sesquioxide component is present only in very small quantities. An example of a sesquioxide is iron oxide or aluminum oxide. The organo-sesquioxide materials form cracked coatings on sand and silt particles or may occur as discrete pellets. The value and chroma of the horizon are approximately 2 or less, or the value is 3 and the chroma is 1 or less. The symbol h is also used in combination with s (Bhs) if the amount of the sesquioxide component is significant but the color value and chroma of the horizon are both 3 or less.

j, Accumulation of jarosite. Jarosite is a potassium or iron sulfate mineral that is commonly an alteration product of pyrite that has been exposed to an oxidizing environment. Jarosite has hue of 2.5YR or yellower and normally has chroma of 6 or more, although chromas as low as 3 or 4 have been reported.

k, Accumulation of carbonates. This symbol is used to indicate accumulation of carbonates, commonly calcium carbonate.

m, Cementation or induration. This symbol is used for horizons that are more than 90% cemented by secondary minerals, though they may be fractured or discontinuous across <10% of the no-pick zone. Roots do not penetrate the cemented portions. The cementing material is also symbolized. In the case of cemented spodic material, if 90% or more of the horizon is cemented by iron, sm is used. If 90% or more is cemented by organo-sesquioxide complexes, hm is used. Guidance will be provided by the contest host to allow students to consistently determine and describe horizons with chemical cementation.

p, Plowing or other disturbance. This symbol is used to indicate disturbance of the surface layer by cultivation, pasturing, or similar uses. A disturbed mineral horizon, even though clearly once an E, B, or C horizon, is designated Ap, unless guidance provided by the contest host is used to designate the horizon differently.

r, Root-limitation by weakly to moderately cemented soft bedrock (paralithic materials). This symbol is used with C horizons. Some of these materials may have undergone significant weathering, but the horizon is still sufficiently coherent to make digging through the horizon with a pick and spade difficult. Fragments may be cut with a spade or knife, snapped apart by hand, or crushed under a boot. Cracks may occur along the original bedrock bedding planes, exfoliation surfaces, or cleavage surfaces within the paralithic materials, but these are few and narrow enough that fine roots cannot penetrate the layer more closely spaced than 10 cm on average.

s, Illuvial accumulation of sesquioxides and organic matter. This symbol is used with B to indicate significant accumulations of illuvial sesquioxides and organic matter. An example of a sesquioxide is iron oxide or aluminum oxide. The symbol s is used in or below horizons with the symbol h (illuvial accumulation of organo-sesquioxide complexes). The symbol s is used to indicate accumulation of sesquioxides and organic matter if either the value or chroma of the horizon is 4 or more. The symbol s is also used in combination with Bh, if both the organic matter and sesquioxide components are significant and if the color value and chroma are both 3 or less.

ss, Presence of slickensides. This symbol indicates the presence of slickensides. Slickensides result directly from the swelling of clay minerals and shear failure, commonly at angles of 20 to 60 degrees above horizontal. They are indicators that other vertic characteristics, such as wedge-shaped peds and surface cracks, may be present.

t, Accumulation of silicate clay. This symbol is used to indicate an accumulation of silicate clay that either has formed in the horizon or has been moved into it by illuviation. The clay can be in the form of coatings on ped surfaces or in pores, lamellae, or bridges between mineral grains.

u, Presence of human-manufactured materials (artifacts). This symbol indicates the presence of manufactured artifacts that have been created or modified by humans, usually for a practical purpose in habitation, manufacturing, excavation, or construction activities. Examples of artifacts are processed wood products, liquid petroleum products, coal, combustion by-products, asphalt, fibers and fabrics, bricks, cinder blocks, concrete, plastic, glass, rubber, paper, cardboard, iron and steel, altered metals and minerals, sanitary and medical waste, garbage, and landfill waste.

v, Plinthite. This symbol is used to indicate the presence of iron-rich, humus-poor, reddish material that is firm or very firm when moist and that hardens irreversibly when exposed to the atmosphere and to repeated wetting and drying. These properties are characteristic of plinthite.

w, Weak development. This symbol is used with B to indicate weak development of structure or alteration of color, or both, with little or no apparent illuvial accumulation of material and the absence of strong gleying. Not used on transitional horizons.

x, Fragipan character. This symbol is used to indicate genetically developed firmness, brittleness, or high bulk density. These features are characteristic of fragipans, but some horizons designated x do not have all the properties of a fragipan.

Many master horizons and layers that are symbolized by a single capital letter will have one or more lower case letter suffixes. Unless otherwise noted, all subordinate distinctions listed in this handbook are allowed, whether the horizon is a master, transitional, or combination horizon.

When more than one suffix is needed, h, r, s, t, and w, if used, are written first. The suffixes t and k are not used with s or h. The suffix w is used with B horizons only and without any other suffix letters, except when part of a buried B horizon. If more than one suffix is needed and the A, E, or B horizon is not buried, c, v, g, m, and x, if used, are written last. Some examples are: Btk, Btss, Btc, Btx, Btxg, Btv, or Bhm. The suffix b is used only for mineral soil horizons other than C horizons buried by a recent deposit of materials, and b is written last.

Numbering suffixes

Horizons or layers designated by the same combination of letters are subdivided by Arabic numerals which follow the letters. Within a C horizon, for example, successive layers could be C1, C2, C3, etc.; or if the lower part has a strongly gleyed matrix and the upper part is not, the designations could be C1, C2, Cg1, Cg2 or C, Cg1, Cg2, R. The numbering starts with 1 at whatever level in the profile any element of the letter symbol changes. Thus, Bt1, Bt2, Btg1, Btg2 is used, not Bt1, Bt2, Btg3, Btg4. The numbering of vertical subdivisions within a horizon is not interrupted at a discontinuity (indicated by a numerical prefix), if the same letter combination is used in both materials; Bt1, Bt2, 2Bt3, 2Bt4 is used, not Bt1, Bt2, 2Bt1, 2Bt2.

Primes

In a profile that has horizons with identical Arabic numeral prefixes and letter combinations separated by one or more horizons with a different horizon designation, the prime symbol (') is used with the lower of the two horizons having identical designations. The prime symbol is not used unless all letters and Arabic-numeral prefixes are completely identical. Vertical subdivisions of horizons or layers (Arabic numeral suffixes) are not taken into account when the prime symbol is assigned. The prime is applied to the capital letter designation, and any lower case symbols follow it. The sequence A, E, Bt, E', Btx, C is an example.

Prefixes

In mineral soils, Arabic numerals are used as prefixes to indicate that a soil has not formed entirely in one kind of material, which is referred to as a lithologic discontinuity, or just a discontinuity. Wherever needed, the numerals precede the master or transitional horizon designation. A discontinuity is recognized by a significant change in particle-size distribution or mineralogy that indicates that the described soil genetic horizons or layers formed in two deposits that are significantly physically or mineralogically different or formed in deposits with a significant difference in age. Stratification common to soils formed in alluvium is not designated as a discontinuity, unless particle-size distribution differs markedly from layer to layer, even if genetic horizons have formed in the contrasting layers.

A prefix numeral is used where a soil has not formed entirely in one kind of material and a discontinuity is present. When a discontinuity of surficial material is identified, prefix numbering starts in the underlying (second) deposit. The surficial deposit must be two or more horizons thick in order to be designated as a discontinuity for this contest. However, there are stricter requirements for designating two parent materials on the scorecard in Part C. The material underlying the surficial deposit is designated by adding a prefix of “2” to all horizons and layers that formed in the second material underlying the discontinuity. There is no minimum number of horizons and layers needed in materials that underlie the surficial deposit. If another discontinuity is found below material with prefix “2”, the horizons and layers formed in the third material are designated by a prefix of “3”. For example, Ap, E, Bt1, 2Bt2, 2Bt3, 3BC. The numeral suffixes designating subdivisions of the Bt horizon continue in consecutive order across the discontinuity. A discontinuity prefix is not used to distinguish material of buried (b) horizons that formed in material similar to that of the overlying deposit (no discontinuity). For example, A, Bw, C, Ab, Bwb1, Bwb2. However, if the material in which a horizon of a buried soil is in a discontinuity below the overlying material, the discontinuity is designated by numeral prefixes and the symbol for a buried horizon is used as well, e.g., Ap, Bw, C, 2Ab, 2Bwb, 2C.

The ^ symbol is placed in front of the master horizon letter to indicate that human-transported materials (HTM) are present. These materials were purposefully collected and moved from one soil to another by human actions, tools, or machinery. These do not include material moved indirectly by human action, such as topsoil moved under accelerated erosion in farmland. The HTM are often confirmed by the presence of artifacts, their occurrence on an evident human-constructed landform, or the evident burial of a natural soil below them on a human- constructed landform. Arabic numeral prefixes may be used before the caret symbol to indicate the presence of discontinuities within the human-transported material layers (e.g., ^A-^C1-2^C2-3Bwb).

Lower Depth

The depth of the lower boundary for each horizon is to be recorded to the nearest cm. Measurements of horizon depths should be made in the undisturbed no-pick zone of the site reserved for this purpose where the horizon boundary crosses a tape or ruler that should be placed close to the nail in the third horizon. If the boundary is not horizontal with the surface, an average depth should be estimated. Boundary measurements should be made at the center of the boundary separating the two horizons, especially when the distinctness of the boundary is not abrupt. Answers will be correct for all depth measurements if they are within the limits allowed by the distinctness of horizon boundaries determined by the official judges.

The maximum depth to be described is not used for any purpose other than describing horizon morphology in Part A. Horizon or layers that begin below the maximum depth to be described are not considered in scorecard Parts B, C, and D. The maximum depth of description is provided at each site by the official judges and it must be deeper than the nail placed in the third horizon. The maximum depth to be described must extend at least five centimeters into the lowest horizon or layer to be described in Part A of the scorecard, as designated by the official judges in the site information. The depth of that lowest horizon or layer should be indicated as the maximum depth to be described followed by a “+” symbol. For example, if the maximum depth to be described is 100 cm, and that depth falls within the lowest horizon or layer to be described, the horizon or layer depth should be designated as 100+ cm. If the maximum depth to be described occurs at a very evident horizon boundary, the horizon or layer depth is designated as 100 cm (and a lower boundary distinctness would need to be entered). The horizon that begins at the maximum depth to be described may be considered for answers in scorecard Parts B, C, and D.

Boundary Distinctness

The distinctness of the lower boundary separating the various horizons must be described when the lower boundary falls at or above the maximum depth to be described indicated by the judges for each site. The categories of distinctness of boundaries are:

Abrupt...................................up to 2 cm, with full credit for answers ±1 cm
Clear...........more than 2 and up to 6 cm, with full credit for answers ±3 cm
Gradual.... more than 6 and up to 16 cm, with full credit for answers ±8 cm
Diffuse .... more than 16 cm

For example, assume the lower depth of the AB is 25 cm and a clear boundary is present, full credit would be given for 22-28 cm. The topography of boundary (such as wavy, smooth, etc.) will not be described in this contest.

Texture

Texture class is determined by the relative percent by weight of sand (2.0 to 0.05 mm) silt (0.05 to 0.002 mm), and clay (<0.002 mm) size separates in the less than 2 mm fraction of the soil material. Soil texture classes are those defined in the Soil Survey Manual. Texture modifiers for sand size (e.g., coarse, fine, very fine) will not be used in the contest. Standard abbreviations for the various textures are given in the Appendix.

In addition to textural class, the weight percent of clay is also estimated for each horizon. Answers within ±4% will be given credit.

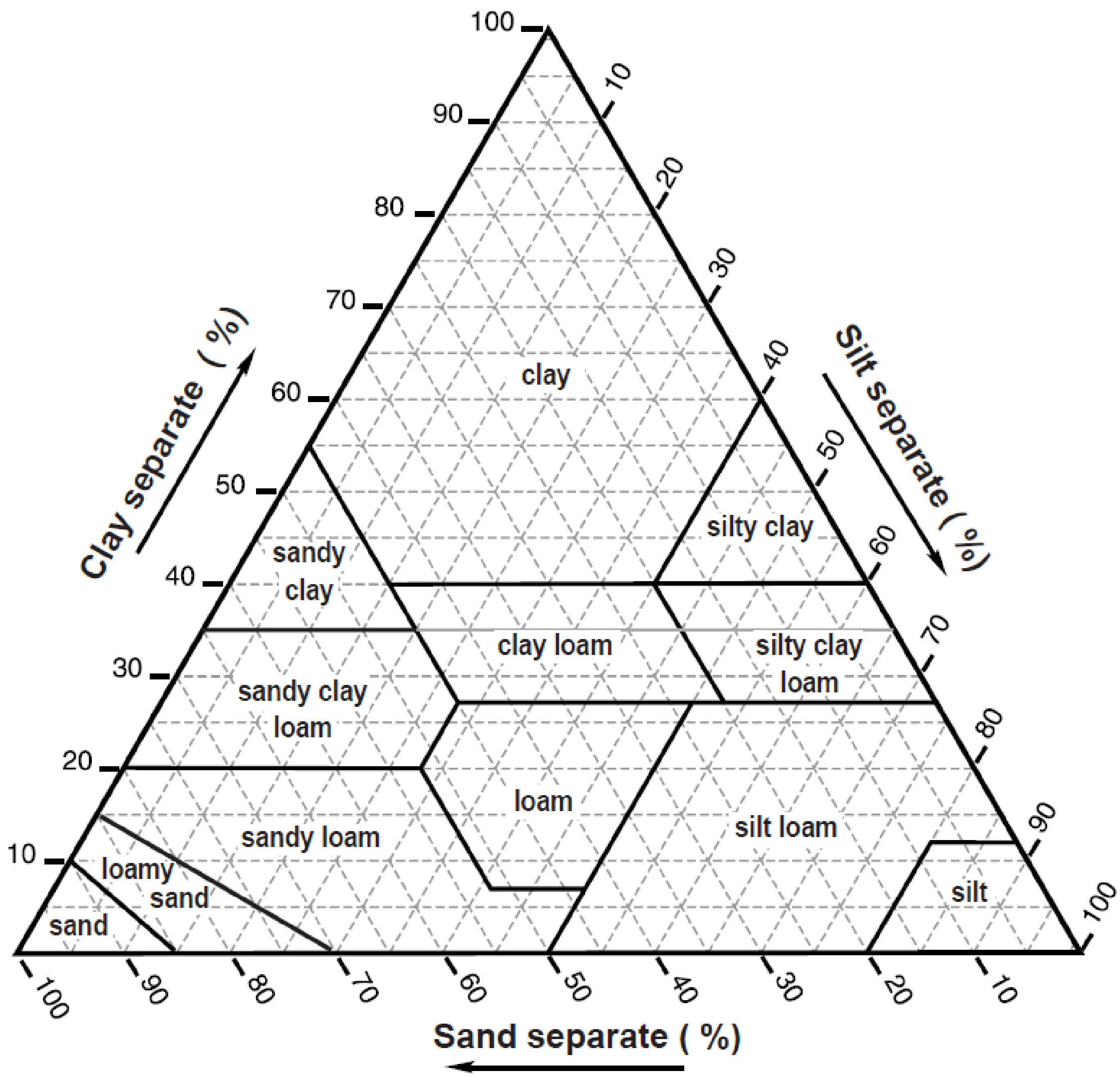
Modifiers to the textural class for rock fragments depends on the abundance and dominant size of fragments. The dominant fragment size is the size class that makes up the greatest total volume of the horizon. When measured across the narrowest axis: gravels range from 2 mm to 75 mm, cobbles range from 75 mm to 250 mm, and stones exceed 250 mm. Boulders are not described in this contest. Flattened shapes of rock fragments are measured across the narrowest axis and are included with the equivalent size class of rounded fragments described above.

(1) For less than 15% by volume rock fragments, no modifier is used.

(2) For 15 to <35% by volume rock fragments, the modifiers gravelly, cobbly, or stony are used (e.g., gravelly sandy loam).

(3) For horizons with 35 to <60% by volume rock fragments, the modifiers very gravelly, very cobbly, or very stony are used (e.g., very gravelly sandy loam).

(4) For horizons with 60% or more by volume rock fragments, the modifiers extremely gravelly, extremely cobbly, or extremely stony are used (e.g., extremely gravelly sandy loam).



Color

Use Munsell soil color books to determine the moist soil color for each horizon described. The Munsell color notation should be used and not the color name (e.g., 10YR 3/2, not "dark brown"). Hue (e.g., 10YR) is the dominant spectral color and is related to wavelength of the light. Value (e.g., 3) refers to the relative lightness of color and is a function of the total quantity of light. Chroma (e.g., 2) is the relative purity of the dominant spectral color.

In some cases, more than one color may be given full credit, especially when the exact color is not in the book. The color of surface horizons is to be judged on the crushed sample which has been moistened to near field capacity and worked to give a uniform sample. The color of subsoil horizons should be determined at moist condition on the broken surface of a ped showing the color of the ped interior. If more than one color is present, only the dominant color should be reported. If two or more colors are dominant, either one will be given full credit. The most common hues in the Southeastern region are 2.5Y, 10YR, 7.5YR, 5YR, 2.5YR, and 10R.

The technique described above for determining moist colors of surface horizons is to be used by the official judges as well as the contestants. Admittedly, this is not the normal method used for official profile descriptions, but it is recommended for this contest because (1) color books are often faded, (2) field moisture may be different from the day the site was officially judged, (3) horizons may have several colors and this method gives an average color, (4) less time is needed in making color determinations, and (5) it allows students to determine colors outside the site.

Structure

Soil structure refers to the aggregation of primary soil particles into compound groups or clusters of particles. These units are separated by natural planes, zones, or surfaces of weakness. Individual aggregates are called peds. Dominant type (shape) and grade (distinctness) of structure for each horizon are to be judged as defined in the Soil Survey Manual. If the horizon lacks definite structural arrangement or there is no observable aggregation, record either structureless-massive or structureless-single grain, whichever is appropriate. Soil structure modifies infiltration rate, permeability (hydraulic conductivity), soil wetness class and surface runoff of a soil.

Grade of Structure

The grade of structure is determined by the distinctness of the aggregates and their durability. Expression of structure grade is often moisture dependent and hence will change with drying of the site.

Structureless. Having no primary or secondary structure.

Weak. Breaks into a very few poorly-formed, indistinct peds, most of which are destroyed in the process of removal. The type of structure is barely observable in place. Clay coatings are thin and interiors of peds look nearly identical to faces.

Moderate. Well-formed, distinct peds are in the disturbed soil when removed by hand. They are moderately durable with little unaggregated material. The type of structure observed in the undisturbed site face may be indistinct.

Strong. Durable peds, very evident in the undisturbed soil of the site face, with very little or no unaggregated material when peds are removed from the soil. The peds adhere weakly to one another, are rigid upon displacement, and become separated when the soil is disturbed.

Shape of Structure

The following terms describe the basic shapes and related arrangement of peds. The columnar category is not found in the Southeast Region and is not included here.

Granular. Spheroids or polyhedrons bounded by curved planes or very irregular surfaces which have slight or no accommodation to the faces or surrounding peds.

Subangular blocky. Polyhedron-like structural units in which the three dimensions are about the same magnitude. Peds have mixed rounded and flattened faces with many rounded vertices. These structure units are casts of the molds formed by the faces of the surrounding peds.

Angular blocky. Similar to subangular blocky but block-like units that have flattened faces and many sharply angular vertices.

Prismatic. Prism-like with the two horizontal dimensions considerably less than the vertical. Vertical faces are well defined and arranged around a vertical line with angular vertices. The structural units have angular tops or caps.

Platy. Plate-like with the horizontal dimensions significantly greater than the vertical dimension. Plates are approximately parallel to soil surface.

Single grain. Structureless material that breaks out into primary particles; sandy textures. (Used only with “structureless” Grade).

Massive. Structureless material that does not break out into primary particles; excavated material cannot be separated into defined structural units. (Used only with “structureless” Grade).

Rock controlled fabric. Structureless material that is a coherent mass, but with the original rock fabric still identifiable. Excavated material may break into defined units, but these are characterized by features inherited from the parent material. (Used only with “structureless” Grade).

Consistence (Rupture Resistance)

Soil consistence (rupture resistance) refers to the resistance of the soil (not rock fragments) to deformation or rupture at various moisture levels. Consistence is largely determined by texture, structure, and humus, although the type of clay and absorbed cations are also involved. Because field moisture will affect consistence, a certain amount of judgment is needed to correct for either wet or dry conditions on the day of the contest. These corrections also should be made by the official judges. Judge the consistence of the moist soil (approximately midway between air-dry and field capacity) for each horizon, as outlined in the Soil Survey Manual, using the terms listed below.

Loose. Soil is noncoherent.

Very friable. Soil aggregates crush very easily under gentle pressure between thumb and finger but cohere when pressed together.

Friable. Soil aggregates crush easily under gentle to moderate pressure between thumb and forefinger and cohere when pressed together.

Firm. Soil aggregates crush under moderate pressure between thumb and forefinger, but resistance to crushing is distinctly noticeable.

Very firm. Soil aggregates crush only under strong pressure; barely crushable with thumb and forefinger.

Extremely firm. Soil aggregates cannot be crushed with thumb and forefinger and must be broken apart bit by bit.

Redoximorphic Features

Redoximorphic features include concentrations, depletions, and depleted matrix. High value (≥4) and low chroma (≤2) colors in the soil may be due to prolonged saturation, color of the parent material, or other features. However, only high value (≥4) and low chroma (≤2) colors related to currently-active prolonged saturation and reduction of iron and manganese oxides (producing redoximorphic depletions or depleted matrix) should be considered in evaluating soil wetness class or soil drainage characteristics.

Redoximorphic features form as a result of microbial reduction of iron and manganese under anaerobic conditions. The absence of oxidized iron and manganese produces the high value (≥4) and low chroma (≤2) colors that identify redoximorphic depletions or depleted matrix. Reduced iron and manganese ions are soluble and may be removed from a soil if vertical or lateral fluxes of water occur, and in extreme cases clay particles are disrupted and the components removed as well. Wherever the reduced iron and manganese is exposed to gaseous oxygen, it becomes oxidized and precipitates to form redoximorphic concentrations. Redoximorphic features are defined for this contest as follows:

Redoximorphic concentrations

The presence or absence of redoximorphic concentrations should be indicated for each horizon. For consistency in identifying cemented concentrations, all concentrations that are soft enough that they at least partially disintegrate or produce dark smear marks on rubbed soil during standard texturing procedures should be identified on the scorecard as active redoximorphic concentrations. Redoximorphic concentrations are precipitated iron and/or manganese oxides, including:

(1) Nodules and concretions (firm, cemented, irregularly shaped bodies with diffuse or sharp boundaries),

(2) Masses (soft bodies of variable shapes within the matrix or around nodules and concretions), and

(3) Linings or coatings in pores, root channels, or on aggregate surfaces.

Redoximorphic depletions

The presence or absence of redoximorphic depletions should be indicated for each horizon. These are zones inside aggregates, linings in pores, root channels, or on aggregate surfaces of high value (≥4) and low chroma (≤2) where either iron-manganese oxides alone or both iron and manganese oxides and possibly clay have been reduced including:

(1) Iron and manganese depletions (zones which are depleted of oxidized forms of iron and manganese due to reduction processes), and

(2) Clay depletions (zones which contain lower than their original amounts of clay due to reduction and removal processes), and

(3) Linings or coatings in pores, root channels, or on aggregate surfaces.

Depleted matrix

As used here, a depleted matrix is indicated when the matrix color has high value (≥4) and low chroma (≤2) due to saturation and reduction processes. The presence or absence of a depleted matrix should be indicated for each horizon. Redoximorphic depletions (as described above) should also be marked as present if they are easily recognizable and have different value but the same or lower chroma than the depleted matrix. Many horizons with depleted matrices also have redoximorphic concentrations and depletions.

Part B. Soil Profile Properties and Interpretations

Infiltration Rate

Infiltration rate is defined as the maximum rate at which water enters the surface mineral soil horizon. It depends upon particle-size distribution, organic carbon content, and structure of the surface horizon as well as soil management and kind of crops (although management is not included as a factor for this contest). The properties of the subsoil, particularly the amount of cracking, influence the infiltration rate to a much lesser degree and are considered for hydraulic conductivity class below. Relationships given below may be used in estimating the infiltration rate.

Rapid. Water enters the soil at a rate greater than 7.5 cm per hour. Normally this class includes horizons with one of the following:

(1) Sand or loamy sand textures, or

(2) Sandy loam textures with greater than 1.2% organic carbon.

Medium. Water enters the soil at a rate of 0.5 to 7.5 cm per hour. This class includes texture and structure combinations not included in the other two classes.

Slow. Water enters the soil at a rate of less than 0.5 cm per hour. This class includes horizons that meet both of the following:

(1) Have either clay, silty clay, or sandy clay textures, and

(2) Is either massive or has weak grade of structure.

Hydraulic Conductivity

Hydraulic conductivity is the rate that water under saturated conditions flows through the soil. The direction of water movement can be either downward or lateral. Saturated flow occurs when the soil water pressure is zero or positive. To determine the most restrictivehydraulic conductivity, identify the subsurface horizon within the profile depth to be evaluated that is considered to have the slowest rate of water movement. Texture, structure, cracking, rock fragment content, and organic matter content usually influence the hydraulic conductivity of a soil. The soil hydraulic conductivity classes for soil judging competition purposes are defined below.

High. Horizons in this class have large connecting pores that transmit water rapidly. This includes subsurface horizons that have sand or loamy sand textures, with or without gravelly texture modifiers. Horizons containing large quantities of rock fragments (>60%) and with insufficient fines to fill many voids between the fragments are also in this class.

Moderate. This class includes texture and structure combinations not included in the other two conductivity classes.

Low. Horizons in this class transmit water slowly. These are:

(1) fragipans; or

(2) horizons with the following combination of properties:

   (a) clayey textures (sandy clay, clay, silty clay), and

   (b) massive or weak grade of structure, or platy shape of structure, and

   (c) value ≥4 with chroma ≤2 redoximorphic depletions or a depleted matrix due to prolonged wetness; or

(3) Cr or R horizons where the horizon directly above contains redoximorphic depletions or a depleted matrix due to prolonged wetness (value ≥4 with chroma ≤2).

Available Water

The available water holding capacity is approximately the water held between field capacity and permanent wilting point. The approximate amount of moisture stored in the soil is calculated for the top 150 cm of the soil. This soil thickness may or may not be the same as that designated for purposes of profile descriptions. The total water is calculated by summing the amount of water held in each horizon or portion of horizon, if the horizon extends beyond 150 cm. If a horizon or layer is unfavorable for roots, this and all horizons below should be excluded in calculating the available moisture. For available water calculations, the properties of the lowest horizon designated for description can be assumed to extend to 150 cm, if the presence of a restrictive layer is not evident. If a restrictive layer is present between the lowest described horizon and the 150 cm depth, the depth to the restrictive layer should be considered for available water estimations. Materials not suited for plant root growth include: (i) horizons with coarse sand or rock fragment modified coarse sand textures with some unfilled voids located directly underneath a horizon of finer-textured soil materials (i.e., very fine sand, loamy very fine sand or finer texture); (ii) bedrock; (iii) fragipans (not just horizons with x); (iv) densic materials (not just horizons with d); (v) horizons cemented across 90% or more of the no-pick zone (horizons with m); and (vi) horizons with very firm or firmer consistence and SiC, C, or SC textures that are structureless and massive.

The relationship between available water retained per centimeter of soil and the textures is given in the table below. If a soil contains many large pebbles and/or rock fragments, the volume occupied by the rock fragments must be estimated and the available water holding capacity corrected accordingly. For example, if a silt loam A horizon is 25 cm thick and contains rock fragments which occupy 10% of its volume, the available water-holding capacity of the horizon would be 25 cm x 0.20 cm/cm x [(100-10)/100] = 4.50 cm of water. Calculate the available water for each horizon to the nearest hundredth, sum all horizons, then round the grand total to the nearest tenth. For example, 14.92 would round to 14.9 in the low class; 15.15 would round to 15.2 in the moderate class.

Available Water Calculation Factors

Available water (cm of water/cm of soil)	Texture classes
0.05	sands, loamy sands
0.15	Textures not included in the other classes
0.20	silt loam, silt, silty clay loam

The available water-holding capacity classes are:

Very low. Up to and including 7.5 cm of water

Low. Greater than 7.5 cm but less than or equal to 15.0 cm of water

Moderate. Greater than 15.0 cm but less than or equal to 22.5 cm of water

High. Greater than 22.5 cm of water

Soil Wetness Class

Soil wetness classes as defined in the Soil Survey Manual will be used. Soil wetness is a reflection of the rate at which water is removed from the soil by both runoff and percolation. Landscape position, slope gradient, infiltration rate, surface runoff, and permeability, are significant factors influencing the soil wetness class. Redoximorphic features, including concentrations, depletions and depleted matrix, are the common indicators of prolonged soil saturation and reduction , and are used to assess soil wetness class. The depth to the shallowest of the following determines the soil wetness class:

(1) The top of an A horizon with:
  (a) Matrix chroma ≤2, and
  (b) Distinct redoximorphic depletions or redoximorphic concentrations as soft masses or pore linings, and
  (c) Redoximorphic depletions or a depleted matrix due to prolonged saturation and reduction in the horizon directly below the A horizon, or

(2) The shallowest observed depth of value ≥4 with chroma ≤2 redoximorphic depletions or depleted matrix due to prolonged saturation and reduction.

Soil Wetness Classes

Class 1. Not wet at depths of less than 151 cm

Class 2. Wet in some part between 101 and 150 cm

Class 3. Wet in some part between 51 and 100 cm

Class 4. Wet in some part between 26 and 50 cm

Class 5. Wet in some part at a depth of ≤25 cm

Soil Use Interpretations

Soil use interpretations are included at the discretion of the host school. The host school must provide interpretations such as in the table below if they are to be used. Depth to seasonally high water table is based on the shallowest observed depth of redoximorphic depletions of value ≥4 with chroma ≤2 or depleted matrix.

Soil Use Interpretations Tables

Dwellings with Basement: Adapted from NSSH Table 620-3 and modified to fit guidelines in the Southeast Region Handbook for Collegiate Soils Contest.

Factors Affecting Use	Degree of Limitation		
	Slight	Moderate	Severe
1. Flooding or ponding frequency	None	Not a choice	Rare to Frequent
2. Slope (pct)	<6	6 - 20	>20
3. Depth to seasonally high water table (cm)	>100	50 - 100	<50
4. Depth to soft rock (Cr) (cm)	>100	50 - 100	<50
5. Depth to hard rock (R) (cm)	>150	100 - 150	<100

Septic Tank Absorption Fields: Adapted from NSSH Table 620-17 and modified to fit guidelines in the Southeast Region Handbook for Collegiate Soils Contest.

Factors Affecting Use	Degree of Limitation		
	Slight	Moderate	Severe
1. Flooding or ponding frequency	None	Not a choice	Rare to Frequent
2. Slope (pct)	<6	6 - 20	>20
3. Depth to seasonally high water table (cm)	>150	100 - 150	<100
4. Limiting hydraulic conductivity	Moderate	Not a choice	Low (percs slowly) or High (poor filter)
5. Depth to rock (R or Cr) (cm)	>150	100 - 150	<100

Local Roads and Streets: Adapted from NSSH Table 620-5 and modified to fit guidelines in the Southeast Region Handbook for Collegiate Soils Contest.

Factors Affecting Use	Degree of Limitation		
	Slight	Moderate	Severe
1. Flooding or ponding frequency	None	Not a choice	Rare to Frequent
2. Slope (pct)	<6	6 - 20	>20
3. Depth to seasonally high water table (cm)	>50	25 - 50	<25
4. Depth to soft rock (Cr) (cm)	>100	50 - 100	<50
5. Depth to hard rock (R) (cm)	>150	100 - 150	<100

Part C. Site Characteristics

Position of Site

Identify the landform on which the soil pit is located. If the pit is in an ambiguous position or the position obscured by the spoil pile, the slope stakes should be placed to reinforce the identity of the position represented by the pit. A topographic map with the pit location marked may also be provided to guide the students in the evaluation of the position of site. The host may reduce the number of position choices for their contest.

Flood Plain

A flood plain is a landform that occurs in the lowest position in a stream valley. Soils are subject to periodic overflow unless artificially protected. Soils found in a flood plain normally have minimal subsoil development. The surficial parent material marked on the scorecard in Part C is alluvium. The host is expected to provide confirmation of flooding to the students on the pit information card (e.g., “This site floods.”).

Stream Terrace

A stream terrace is a nearly level landform parallel to and adjacent to a flood plain (or a lower stream terrace), but in a higher position than the active flood plain. At least one of the parent materials marked in Part C is alluvium. Some stream terraces are subject to periodic flooding, but not as frequently as an adjacent lower-lying flood plain. Weak to moderate soil development is found on low-lying terraces that flood, while moderate to strong subsoil development is found on non-flooded terraces. It is often difficult to consistently identify geologically older, dissected terraces or isolated terrace remnants that are not evidently associated with a stream or river. The criteria for identifying such terraces that are not evidently associated with a stream or river is host school dependent. Stream terraces in a footslope position covered by colluvium thick enough to be marked in Part C of the scorecard should be marked as footslopes. The host is expected to provide confirmation of flooding to the students on the pit information card (e.g., “This site floods.”).

Alluvial Fan (optional)

An alluvial fans is a cone-shaped deposit of alluvium made where an intermittent stream gradient decreases rapidly over a short distance, causing rapid deposition of suspended alluvial sediment. Most alluvial fans form where a stream valley intersects a larger, more level valley, often in a perpendicular flow direction. Alluvial fans currently flood in some part. The contest host is to inform students if the pit is placed in a flooded area. The surficial parent material marked on the scorecard in Part C is alluvium. Weak to moderate soil development is found on alluvial fans in the southeast region.

Footslope

A footslope is a linear or concave landform downhill from an inflection point where the slope angle decreases and upslope eroding sediment collects. Older or highly dissected footslopes may be found in steep or in mountainous terrain on uplands. In both cases, Footslope is marked on the scorecard in Part C whenever the surficial parent material in Part C is colluvium. Weak to strong subsoil development is usually evident, depending on the upslope stability and age of the deposit.

Depression

A depression refers to the nearly level bottom of a closed basin landform which has no visible external surface drainage. Ponding of water may occur following periods of heavy rainfall. If the soil pit occurs in the bottom of a closed basin that is within an upland or floodplain site, the students should check only the “depression” position on the scorecard. Depressions may include such features as limestone sinks and sink holes, or low closed basins on floodplains or coastal plains. A depression should be a natural feature, and may be altered by but not be formed as the result of some man-made structure. For example, if an embankment crosses a drainageway and creates a closed basin, or if humans excavate a pond, they are not considered natural features. Parent material is variable. The host is expected to provide confirmation of flooding or ponding to the students when it occurs.

Drainageway (optional)

A drainageway is a natural landform that collects and carries very brief (ephemeral) surface flow from a microwatershed to a floodplain or depression. Drainageways should have a higher gradient compared to the flood plains or depressions they intersect and as such they are dominantly erosional features. Drainageways can be found on any position higher than flood plains or depressions. Parent material is variable. The host is expected to provide confirmation of flooding to the students when it occurs.

Upland

The upland includes landforms and positions that do not fit the definition of any other position or landform described in this handbook. Soil development is variable. The surficial parent material is not alluvium as defined below.

Constructed (optional)

A constructed landform refers to any of a number of human-modified deposits of natural earth materials (e.g., soil, gravel, rock) or waste materials (e.g., tailings from dredging or spoil from mining). Such a human-modified landform exhibits substantial and permanent alterations of the physical shape and /or internal stratigraphy of the land. In other cases, the human-transported materials (HTM) have been placed and shaped to approximate natural contours, as is commonly done during land-reclamation efforts after mining operations. The surficial parent material marked on the scorecard in Part C is human-transported materials.

Parent Material

Some sites may have multiple parent materials, such as loess over residuum, colluvium over residuum, etc. A parent material must include one or more horizons or layers beneath the surface A horizons to be marked in Part C on the scorecard as a separate parent material. A horizons do not include transitional horizons. The host may reduce the number of parent material choices for their contest.

Loess

Loess is unsorted, wind-blown, silty material that blankets the landforms it fell upon. Loess originated as mainly silt-sized particles carried by large streams, and most deposition occurred during the late Pleistocene. Loess has a high content of weatherable minerals and high base saturation at the time of deposition.

Residuum

Residuum includes materials accumulated through the weathering of bedrock in place. The nature of the rock fragments vary from place to place and may include igneous, sedimentary, and metamorphic types. In some soils, rock-controlled structure or in-place rock fragments may be observed in the lower part. There is little or no sorting by wind or water, although stone lines may exist as evidence of erosion and deposition of an overlying parent material above.

Colluvium

Colluvial deposits have little or no sorting and have been transported by gravity flow or hillside erosion (i.e., local alluvium) and are not associated with an individual stream or channelized flow. Recently transported colluvium is found on footslope landforms, although older deposits or deposits in mountainous terrain may be found on a variety of landscape positions. Colluvium may contain a mixture of rock fragment types with variable size and orientation within a horizon, or it may contain a mismatch between rock fragments in upper horizons with those of horizons below that retain rock-controlled structure or in-place rock fragments below. In mountainous areas, colluvium may also be identified as the material on hillsides or summits above a stone line (a lag concentrate of rock fragments marking a former eroded surface, now buried beneath transported materials).

Alluvium

Alluvium is material transported and deposited by flowing water or in ponded depressions. It includes material on flood plains, stream terraces, alluvial fans, and some drainageways and depressions. Evidence of sorting by flowing water (stratification) may occur in several forms, including irregular variability of particle size with depth, especially of sand and rock fragment sizes. For example, thin strata (layers) of sandy textures alternating with silty textures, or a change from non gravelly to extremely gravelly textures indicate irregular deposition due to variation in the velocity of flowing water. Rounded rock fragments sorted by size are also clues of movement by flowing water. In flooded areas, the soil may contain buried horizons and is coarser-textured nearest the active channel, becoming finer-textured away from the channel. There may be a natural levee next to the channel and gravel bars next to the stream.

Unconsolidated Coastal Plain Sediments

Unconsolidated Coastal Plain sediments include Tertiary-aged or younger materials deposited by wind and water in both marine and non-marine environments that have not undergone compaction to the extent that they would be classified as a rock. The sediments are usually stratified and may be any size. Some soils contain secondary precipitated minerals that cement horizons or layers such as ironstone, plinthite, or ortstein. The contest host is asked to provide diagnostic evidence to the students to allow them to distinguish the unconsolidated Coastal Plain sediments from more recent alluvium found on floodplains and stream terraces.

Eolian Sands

Eolian sand is sandy soil material which has accumulated into dunes, swales, and flats topography by wind action. Eolian sands have a larger particle-size than loess, and forms when an unvegetated sand source is exposed to prevailing wind action. There may be sorting of grain sizes.

Lacustrine

These deposits consist of materials that have settled out of bodies of still water. For this contest, lacustrine sediments are associated with glacial lakes and other slackwater features, including local damming of headwater tributaries. As such, lacustrine deposits are found on terrace landforms. These slackwater deposits are generally textures of silt loam or finer, and lack rock fragments.

Pedisediment

Pedisediment is a mixture of generally unsorted alluvial and colluvial materials found in upland landscape positions as a result of large scale geological erosion/deposition processes. The contest host will provide diagnostic guides to the students and coaches to allow them to identify this material from all other materials if this parent material is to be a choice the contest.

Human-transported Materials

Human-transported material (HTM) is any solid or liquid material moved and deposited by intentional human activity, usually with the aid of machinery. Common types of HTM include dredge deposits, construction debris, mine spoil, and other waste materials (ash, sludge, slag). Observed properties of HTM include disordered rock fragments, freshly fractured rock fragments with sharp or splintered edges, bridging voids between rock fragments, pockets of dissimilar materials, detached fragments of diagnostic horizons, buried artifacts, carbolithic materials, layers compressed by machinery, irregular distribution of organic matter, and the presence of strongly contrasting topsoil or underlying materials. The key to identification is ruling out deposition by natural forces or processes.

Soil Slope

Slope refers to the inclination of the surface of the soil. A slope has length, shape, and gradient. Gradient is usually expressed in percent slope and is the difference in elevation, in feet, for each one hundred feet of horizontal distance. Slope may be measured by an Abney level or clinometer. Slope classes are based on the gradient. The percentage limits on slope classes vary from region to region, depending on the rate at which erosion occurs. These percentage limits will be included on the scorecard used for each contest. Slope classes include: nearly level (0 to 2%), gently sloping (>2 to 6%), sloping (>6 to 12%), strongly sloping (>12 to 20%), moderately steep (>20 to 30%), and steep (>30%). The dominant slope class (i.e., encompassing the largest sub-area) within the area should be used to characterize the site. Stakes or markers will be provided at each site for determining slope, and the slope should be measured between these two markers.

Surface Runoff

The surface runoff classes are those listed and described in the Soil Survey Manual. Runoff, as related to soil science, refers to the relative rate that water flows over the surface of the soil. The rate is determined to a great extent by slope gradient, however, properties of the soil that affect infiltration and percolation rates also affect runoff. The following are brief descriptions of the runoff classes.

Ponded. None of the water added to the soil by precipitation or by flow from surrounding higher land escapes as runoff. Ponding normally occurs in depressions.

Very slow. Added water flows away so slowly that free water lies on the surface for long periods. Much of the water enters and passes through the soil or evaporates. Very open and porous soils in which the water enters immediately are also considered to have very slow runoff. Soils with very slow surface runoff are commonly nearly level, i.e., less than 2% slope gradient.

Slow. Added water flows so slowly that free water covers the soil for significant periods, or a large part enters the soil in the case of sandy or porous soils. There is usually little or no erosion problem. These soils are usually nearly level or gently sloping.

Medium. Added water flows away at such a rate that moderate amounts enter the soil and free water lies on the surface for only a short period. The erosion hazard is slight to moderate, if cultivated. These soils are usually gently sloping or sloping.

Rapid. A large portion of added water moves rapidly over the surface with only a small part entering the soil. These soils may be on strongly sloping, moderately steep, or steep slopes. The erosion hazard is moderate to high.

Very rapid. A small part of the added water enters the soil and surface water runs off as fast as it is added. These soils are steep to very steep and have low infiltration capacities. The erosion hazard is high or very high.

Surface Runoff Classes

The following table giving the relationships between soils in various topographic settings and infiltration rates may be used to determine runoff classes.

	Rapid Infiltration	Medium Infiltration	Slow Infiltration
Depression	Ponded	Ponded	Ponded
0-1% slope	Very slow	Very slow	Slow
>1-2% slope	Very slow	Slow	Medium
>2-6% slope	Slow	Medium	Rapid
>6-12% slope	Medium	Rapid	Very rapid
>12% slope	Rapid	Very rapid	Very rapid

Soil Erosion Potential

Soil erosion potential refers to the likelihood of soil erosion by water. The potential for future erosion losses is influenced mainly by the texture of the surface soil and the amount of surface runoff at a site. Soil erosion potential is estimated using the following table.

Soil Erosion Potential Classes

The following erosion table assumes granular structure or structureless - single grained in the surface horizon and that the soil is bare, although in this contest there is no adjustment if that is not the case.

	Surface Horizon Texture			
Surface Runoff	S, LS	SCL, SC	SL, CL, C, SiC	L, Si, SiL, SiCL
Ponded	Very Low	Very Low	Very Low	Very Low
Very slow	Very Low	Very Low	Low	Medium
Slow	Very Low	Low	Medium	Medium
Medium	Very Low	Low	Medium	High
Rapid	Low	Medium	High	Very High
Very Rapid	Medium	High	Very High	Very High

Part D. Soil Classification

The classification of the soil at the order level is largely determined from the various diagnostic horizons. The definitions for the diagnostic horizons listed below were condensed from *Soil Taxonomy*. Because of the variable number of soil orders and diagnostic horizons present in the different states of the region, the host school may choose to list only the most common ones in the scorecard. The host school must notify the competing schools of the soil orders and diagnostic horizons to be included in the scorecard. Only soil taxonomic classes found in the host school region shall be included on the card. The host may reduce the number of taxonomic choices for their contest.

Diagnostic Surface Horizons: Epipedons

Epipedons are simply the uppermost soil horizons. The word epipedon is derived from two words, “epi” meaning over or upon and “pedon” meaning soil. It should be noted that the following discussion as per surface and subsurface diagnostic horizons is mostly general in nature unless otherwise noted. Official definitions, as will be used in this contest, are found in the Keys to Soil Taxonomy. In most instances, only diagnostic horizons important to the Southeastern region are discussed.

Mollic Epipedon

A dark colored, soft, mineral surface horizon dominated with divalent cations and typically with moderate or strong structure. The color requirements include chromas less than 3.5 when moist and values darker than 3.5 when moist and 5.5 when dry. The chemical properties include base saturation (by NH_4OAc) of 50% or more with calcium usually the dominant cation, and an organic carbon content of 0.6%or more. For purposes of judging soils in the Southeastern region, one should assume that: (1) the dry color value is one chip higher than the moist color value, (2) the organic carbon is met if the color requirements are met, unless data given indicate otherwise, (3) dark-colored horizons do not become both massive and hard or harder when dry, and (4) other requirements for P content, moisture content, and N-value are met.

The thickness of a mollic epipedon must be 10 cm or more if lying directly over a lithic or paralithic contact. In other soils, the epipedon must be 25 cm or more thick if (a) the base of any argillic, natric, spodic, or cambic horizon extends deeper than 75 cm, and (b) the upper boundary of the shallowest of a fragipan or a horizon with identifiable secondary carbonates is deeper than 75 cm. For soils that fail to meet either (a) or (b), the mollic epipedon must be 18 cm or more thick and more than one-third of the thickness between the top of the epipedon and the shallowest feature that failed (a) or (b). For soils with textures loamy fine sand or coarser throughout the profile, the thickness of the mollic must be 25 cm or more. A 25-cm thickness is also required for soils which do not have an underlying diagnostic horizon (as in recent alluvium that is not finely stratified and have an irregular decrease in organic carbon with depth). In all other conditions, the thickness must be 18 cm or more if the above thickness criteria are met.

Ochric Epipedon

These horizons have the characteristics which do not qualify them for any other epipedons. They are too light in color, too high in chroma, too low in organic carbon, or too thin to qualify as one of the other diagnostic horizons. They may, for example, have all criteria for a mollic epipedon but be too hard or massive when dry. This type of epipedon is common for soils which have been eroded and the E or B horizons have been mixed with the Ap. The ochric epipedon does not have relict rock structure and does not include finely stratified fresh sediments, nor can it be an Ap horizon directly overlying such deposits.

Umbric Epipedon

This is a dark surface horizon that cannot be distinguished from a mollic epipedon by the eye. It differs from the mollic epipedon only by having a base saturation (by NH_4OAc) of less than 50% in some part, which can only be identified with supporting laboratory data.

None (optional)

In soils where either rock controlled fabric (structure defined by the original bedding planes of weathered bedrock) or finely-stratified recent sediments make up 50% or more of the volume of a layer that occurs within 18 cm or starts at the base of the plow layer, there is no epipedon and “none” is indicated.

Diagnostic Subsurface Horizons

These horizons form below the surface of the soil, although some may at times form immediately below a layer of leaf litter. They may be exposed at the surface by truncation. These horizons are generally considered to be E or B horizons.

Albic

An albic horizon is one from which clay and free iron oxides have been removed or in which the oxides have been segregated so that the color of the horizon is that of the mineral grains present. Typically, it is an E horizon with certain color limitations. It may lie just above an argillic or spodic horizon or between a spodic horizon and either an argillic horizon or fragipan; or it may lie between an argillic horizon and a fragipan or cambic horizon and an argillic, natric, or fragipan horizon.

An albic horizon must be 1 cm or more thick and must be made of 85% or more of albic materials. Albic materials meet the following criteria:

(1) Chroma of 2 or less; and either
  (a) A color value, moist, of 3 and a color value, dry, of 6 or more; or
  (b) A color value, moist, of 4 or more and a color value, dry, of 5 or more; or
(2) Chroma of 3 or less; and either
  (a) A color value, moist, of 6 or more; or
  (b) A color value, dry, of 7 or more; or
(3) Chroma that is controlled by the color of uncoated grains of silt or sand, hue of 5YR or redder, and the color values listed in item 1-a or 1-b above.

For purposes of judging soils in the Southeastern region, one should assume that the dry color value is one chip higher than the moist color value. Relatively unaltered layers of light colored sand, volcanic ash, or other materials deposited by wind or water are not considered albic materials, although they may have the same color and apparent morphology. These deposits are parent materials that are not characterized by the removal of clay and/or free iron and do not overlie an illuvial horizon or other soil horizon, except for a buried soil

Argillic

An argillic horizon is an illuvial horizon in which layer-silicate clays have accumulated to a significant extent by illuviation. They have formed below the surface of a mineral soil but may be exposed at the surface by erosion. In general, this is a B horizon which has an increase in clay content relative to that of the eluvial horizon above and has evidence of clay translocation as films, pore linings, or bridging between sand grains. The increase in clay content occurs within a vertical distance of less than 30 cm. If the eluvial horizon is greater than 40% clay, the absolute increase of clay needed is only 8%. For sandy soils with less than 15% clay, an absolute increase of 3% is required for meeting the criteria of an argillic horizon. In other soils, if the clay content of the eluvial horizon is between 15 and 40%, a relative increase in clay of 20% (1.2x) is needed to meet the requirements for an argillic horizon.

Coatings of oriented clay (clay skins or argillans) occur on some of the vertical and horizontal surfaces of pores and of peds somewhere within or immediately below many illuvial horizons. Coatings are very commonly only at the base of the horizon. In sandy textures, clay coatings are absent and clay is seen bridging sand grains with a 10-x hand lens. These clay coatings or bridges may differ from that of the ped interior not only in texture, but also in color. Relict rock structure and fine-stratification from flooding is absent in half or more of the volume of the argillic horizon. The argillic horizon must be at least one-tenth the thickness of all the overlying horizons and meet a minimum thickness based on texture.

The argillic horizon must meet the following criteria:

(1) Contains more clay than the eluvial horizon, and this clay increase must be reached within a vertical distance of 30 cm or less. If an eluvial horizon remains, and there is no lithologic discontinuity, the argillic horizon contains more total clay than the eluvial horizon as follows:

(a) If the eluvial horizon contains <15% clay, the argillic horizon contains at least 3% more clay (absolute) than the eluvial horizon (e.g., ≥13 vs. 10%). In sandy soils, 3% chosen because it was felt this is the lower limit of detection in the field.

(b) If the eluvial horizon contains >15 and <40% clay, the argillic horizon must contain at least 20% more clay (relative) than the eluvial horizon (e.g., 25% x 1.2, or ≥30%) (1.2 times more clay than the eluvial horizon).

(c) If the eluvial horizon contains >40% clay, the argillic horizon must contain at least 8% more clay (e.g., ≥50 vs. 42% clay). Eight percent was felt to be the lower limit in the clayey (>40% clay) soils).

(2) Thickness is 7.5 cm minimum if soil is clayey or loamy; 15 cm minimum for sandy-textured (very fine sand, loamy very fine sand or finer) soils. In sandy soils, thickness of lamellae (clay accumulations in bands) that are 1 cm or more thick may be added together with a Bt horizon to meet the minimum thickness.

(3) Evidence of translocated (oriented) clay. A clay increase alone is not sufficient evidence for an argillic horizon. The horizon with more clay must contain evidence that clay has been translocated such as clay coatings or bridges.

Calcic

A calcic horizon is the result of the secondary accumulation of calcium carbonate or calcium and magnesium carbonate.

The calcic horizon must meet the following criteria:

(1) Is 15 cm or more thick; and:

(2) Is not indurated or cemented by $CaCO_3$ to such a degree that it meets the requirements of a petrocalcic horizon; and

(3) Has one or more of the following:

(a) Fifteen percent or more $CaCO_3$ equivalent, (see below) and its $CaCO_3$ equivalent is 5 percent or more (absolute) higher than that of an underlying horizon; or

(b) Fifteen percent or more $CaCO_3$ equivalent, and 5 percent or more (by volume) identifiable secondary carbonates; or

(c) Five percent or more calcium carbonate equivalent and has:

(i) Less than 18 percent clay in the fine-earth fraction; and

(ii) A particle size that is sandy, sandy-skeletal, coarse-loamy, or loamy-skeletal; and

(iii) A weight of identifiable secondary carbonates, that is 5 percent or more (absolute) higher than that of an underlying horizon.

Cambic horizon

The cambic horizon is an altered nonilluvial horizon having a texture of the fine earth faction that excludes all coarse-textures such as sands and loamy sands, unless those two textures are dominated (>50% by vol.) by particles of very fine sand size. This horizon may show some of the properties of an argillic horizon with some development of a B horizon, but there has not been sufficient clay movement to qualify for argillic. In addition, the requirements for a fragipan or spodic horizon are not met. The cambic cannot have properties of an umbric or mollic epipedon. The soil particles may be aggregated into structural peds. The cambic horizon, except for truncated soils, must lie immediately below one of the diagnostic epipedons and cannot be below an argillic or spodic horizon. It is considered a part of the solum and therefore reached by roots of native plants. Cambic horizons may form as a result of fluctuating groundwater table or in a well-drained position. The presence of redoximorphic features alone is not evidence of sufficient alteration for identification of the cambic horizon.

Cambic horizons must meet the following criteria:

(1) Thickness is 15 cm or more, whether a continuous horizon of the sum thickness of lamellae, and

(2) Texture that is very fine sand, loamy very fine sand or finer, and

(3) Has soil structure in at least half the volume of the horizon or absence of rock structure in at least half the volume of the horizon, and

(4) Shows evidence of alteration in one of the following forms:

- (a) Aquic conditions within 50 cm of the soil surface or artificial drainage and all of the following:
  - (i) colors that do not change on exposure to air, and
  - (ii) dominant color, moist, on faces of peds or in the matrix as follows:
    - (1) value of ≤3 and chroma of 0, or
    - (2) value of ≥4 and chroma of ≤1; or
    - (3) any value, chroma of ≤2, with redoximorphic concentrations, and
- (b) Does not have the combination of aquic conditions within the upper 50 cm or artificial drainage and the colors described in 4 (a), but has one of the following:

(i) Higher chroma, higher value, redder hue, or higher clay content than the underlying or overlying horizon, or

(ii) evidence of removal of carbonates or gypsum, and

(5) Does not meet requirements for mollic or umbric epipedons, or fragipan, argillic, calcic, natric, or spodic diagnostic horizons, and

(6) Is not part of an Ap horizon and is not brittle in 60% of the matrix.

Fragipan

A loamy subsurface horizon, often (but not required to be) underlying a cambic, spodic, argillic, or albic horizon. It has a very low organic carbon content, high bulk density relative to horizons above it, and hard to very hard consistence. It is brittle and appears to be cemented when dry, but aggregates dissolve in water overnight. When moist, it has moderate or weak brittleness, and peds tend to rupture suddenly with pressure. It is usually mottled and has a slow to very slow permeability. It is virtually free of roots, except along bleached prism faces. Commonly, it has an abrupt or clear upper boundary that is wavy and <100 cm below the mineral surface. Clay skins are patchy or discontinuous. Some fragipans have moderate to strong platy structure within large prisms. In other fraipans, the structure within prisms is more nearly blocky or subangular blocky. In other fragipans, the prisms have no secondary structure.

Fragipans have the following characteristics:

(1) The layer is 15 cm or more thick; and

(2) The layer has very coarse prismatic, columnar, or blocky structure of any grade, has weak structure of any size, or is massive. Separations between structural units that allow roots to enter have an average spacing of 10 cm or more on the horizontal dimension; and

(3) The layer has, in 60% or more of the volume, a firm or firmer moist consistence (rupture-resistance) class, a brittle manner of failure at or near field capacity, and

(4) The layer is not effervescent (in dilute HCl).

Kandic horizon

The kandic horizon is a vertically continuous subsurface horizon (not composed of lamellae) with a significantly finer texture than the overlying horizon or horizons. It's properties and genesis are very similar to those of the argillic horizon. The kandic horizon may underlie an ochric, umbric, or mollic epipedon. The upper boundary normally is clear or gradual, although it may be abrupt, but is never diffuse. The increase in clay content is reached within a vertical distance of 15 cm or less.

The Kandic horizon must meet the following criteria:

(1) Starting at the point where clay increase requirements are met, CEC (pH 7) <16 cmol(+)/kg clay and ECEC <12 cmol(+)/kg clay in at least 1/2 of the thickness of the next 100 cm (or 1/2 the thickness to a lithic or paralithic contact), and

(2) Has a thickness of at least 30 cm (at least 15 cm and 60% of vertical distance between 18 cm and limiting layer if limiting layer starts at depth <50 cm), and

(3) Has texture of loamy very fine sand or finer, and

(4) Underlies a coarser textured surface horizon at least 18 cm thick or 5 cm thick if the boundary to the kandic horizon is abrupt, and

(5) Has more total clay than the overlying horizon as follows:

- (a) if surface horizon has <20% clay, kandic begins where some subhorizon has at least 4% more clay (absolute) than the overlying horizon, or
- (b) if surface horizon has 20 to 40% clay, kandic begins where some subhorizon has 20% more clay (relative) than the overlying horizon, or
- (c) if surface horizon has >40% clay, kandic begins where some subhorizon has 8% more clay (absolute) than the overlying horizon.

In the Southeast Region, CEC data will be given in units of CEC (pH 7) cmol(+)/kg clay.

Natric horizon

The natric horizon is a special type of argillic horizon characterized by the presence of a significant amount of sodium. It has, in addition to the properties of the argillic horizon, prismatic or columnar structure that may or may not break into blocks. Natric horizons have more than 15% of the exchangeable cation sites occupied by sodium, or more exchangeable magnesium plus sodium than calcium plus exchangeable acidity in a subhorizon within 40 cm of the upper boundary. These soils are more common in dry climates but may also be found in poorly drained soils in humid climates. Lab data must be given to confirm the sodium content.

Spodic horizon

The spodic horizon is the result of an illuvial accumulation of amorphous materials composed of organic matter and aluminum with or without iron. These materials have high exchange capacity, surface area, and water retention. These horizons are most common in soils in cold, temperate climates, but also occur in warmer climates or lower elevations if in a thick sandy soil with a high organic carbon input and a fluctuating water table, such as near the oceans. They may form in well-drained soils in cold regions or soils with fluctuating groundwater levels, but they do not seem to form in permanently saturated soils. In unaltered soils, the spodic horizon usually lies below an albic horizon. They are most commonly formed in coarse-textured (sandy, coarse-loamy or coarse-silty) acid parent materials. The spodic horizon has a subhorizon greater than 2.5 cm thick where sand grains are coated, covered, or bridged by organic matter-aluminum complexes or by organic matter in complex with both aluminum and iron. The upper boundary is usually abrupt. In some cases, a definite structure is hard to distinguish because of its weak strength. Clay coatings are not present. Most spodic horizons have hues of 10YR or redder; the value and chroma, under moist conditions are generally 5/6, 4/4, 3/2, or 2/1. If the albic horizon overlies the spodic horizon, there is seldom any difficulty in recognizing the illuvial portion of the spodic horizon. There may be a second maximum of organic carbon in the spodic horizon and possibly a second eluvial horizon between. Normally, the spodic horizon underlies an O, A, Ap, or E horizon. Components are usually named Bh, Bhs, or Bs.

Spodic horizons must meet the following criteria:

A spodic horizon must have 85 percent or more *spodic materials* in a layer 2.5 cm or more thick.

Spodic materials must meet the following criteria:

(1) A pH value in water (1:1) of 5.9 or less and an organic carbon content of 0.6 percent or more; and

(2) One or both of the following:

  (a) An overlying albic horizon that extends horizontally through 50 percent or more of each pedon and, directly under the albic horizon, crushed and smoothed colors, as follows:

    (i) Hue of 5YR or redder; or

    (ii) Hue of 7.5YR, color value of 5 or less, and chroma of 4 or less; or

    (iii) Hue of 10YR or neutral and a color value and chroma of 2 or less; or

    (iv) A color of 10YR 3/1; or

  (b) One of the colors listed above or hue of 7.5YR, color value, moist, of 5 or less, chroma of 5 or 6 (crushed and smoothed sample), and one or more of the following morphological or chemical properties:

    (i) Cementation by organic matter and aluminum, with or without iron, in 50 percent or more of each pedon and a very firm or firmer rupture-resistance class in the cemented part; or

    (ii) 10 percent or more cracked coatings on sand grains; or

    (iii) Al + 1/2 Fe percentages (by ammonium oxalate) totaling 0.50 or more, and half that amount or less in an overlying umbric (or subhorizon of an umbric) epipedon, ochric epipedon, or albic horizon; or

    (iv) An optical-density-of-oxalate-extract (ODOE) value of 0.25 or more, and a value half as high or lower in an overlying umbric (or subhorizon of an umbric) epipedon, ochric epipedon, or albic horizon.

In the Southeast Region, unless lab data are given, students can assume that materials that meet the color requirements of part 2 above also meet the listed requirements for pH, organic carbon, cracked coatings, Al + 1/2 Fe percentages and ODOE values.

Sulfuric

A horizon 15 cm or more thick composed either of mineral or organic soil material that has both a pH less than 3.5 and precipitated jarosite (iron-sulfate) indicated by masses of 2.5Y or yellower and chroma of 6 or more. This horizon forms as a result of artificial drainage and oxidation of sulfide-rich minerals or organic materials. Lab data must be given to confirm the pH and presence of sulfate.

Other Diagnostic Characteristics

These characteristics have been referred to in the handbook and enter into decisions concerning scorecard Sections B and D.

Paralithic Contact

A paralithic contact is a contact between soil and paralithic materials where the paralithic materials have no cracks or the spacing of cracks that roots can enter is 10 cm or more. Paralithic materials are weakly- to moderately-cemented bedrock materials and are designated as C horizons with a subordinate designation of “r”.

Lithic Contact

A lithic contact is the boundary between soil and an underlying moderately- or strongly-cemented bedrock layer designated as R that is continuous across the no-pick zone.

Lithologic Discontinuity

A lithologic discontinuity is a significant change in particle-size distribution or mineralogy that indicates that the described soil genetic horizons or layers have formed in two or more deposits that are significantly physically or mineralogically different or formed in two or more deposits with a significant difference in age. Stratification common to soils formed in alluvium is not designated as a discontinuity even if unless particle-size distribution differs markedly from layer to layer, unless even if genetic horizons have formed in the contrasting layers.

None

None of the diagnostic horizons or characteristics listed by the contest host are found in the described soil.

Order

Orders are defined in the latest Keys to Soil Taxonomy and Soil Taxonomy. Orders that can occur within the Southeast Region include Ultisols, Alfisols, Mollisols, Histosols, Entisols, Inceptisols, Spodosols, Vertisols. Histosols are not described in this contest. When separating Ultisols from Alfisols, students are to assume that the base saturation data (by NH_4OAc) supplied by the host are to be used as if they were equivalent to base saturation by sum of cations.

APPENDIX

Abbreviations

Either uppercase or lowercase is allowed. A dash or blank are incorrect for these categories below (except for rock fragment modifiers). For Cr and R layers, dashes may be used in all boxes to the right of bottom depth, unless a boundary distinction is needed.

Distinctness of Boundary

Abrupt = A	Gradual = G
Clear = C	Diffuse = D

Texture

Sand = S	Loamy Sand = LS	Sandy Clay Loam = SCL
Loam = L	Sandy Loam = SL	Silty Clay Loam = SiCL
Silt = Si	Silt Loam = SiL	Sandy Clay = SC
Clay = C	Clay Loam = CL	Silty Clay = SiC

Modifiers of Rock Fragment Quantity and Size

Enter a dash if none of the following apply.

Gravelly = GR	Cobbly = CB	Stony = ST
Very Gravelly = VGR	Very Cobbly = VCB	Very Stony = VST
Extr. Gravelly = XGR	Extr. Cobbly = XCB	Extr. Stony = XST

Structure Grade

Structureless = SLS
Weak = WK
Moderate = MO
Strong = ST

Structure Shape

Granular = GR	Angular Blocky = ABK
Platy = PL	Subangular Blocky = SBK
Prismatic = PR	Massive = MA
Single Grain = SG	Rock-Controlled Fabric = RCF

Consistence

Loose = L	Firm = Fi
Very Friable = VFR	Very Firm = VFi
Friable = FR	Extremely Firm = EFi

Redoximorphic Features

Enter Yes or Y for any that are present and No or N if none are present.