



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L419

Soil Color – Munsell Lab Confirmation

Standard Operating Procedure

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Table of contents

1 Purpose	1
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	3
5.1 Required PPE	3
6 Equipment and Materials	3
7 Procedure	3
7.1 Lighting Setup	3
7.2 Sample Preparation	4
7.3 Color Determination	4
7.4 Recording Results	4
7.5 Special Cases	5
8 Quality Control and Acceptance Criteria	5
9 Waste Disposal	5
10 References	5
11 Training Record	5

1. Purpose

This procedure describes the determination of soil color under controlled laboratory lighting using the Munsell Soil Color Charts. Soil color is a rapid, non-destructive indicator of organic matter content, mineralogy, drainage condition, and degree of weathering. It is a required observation in soil profile descriptions and is used in soil taxonomy (e.g., distinguishing Mollisols by dark surface colors) (Lynn & Pearson, 1993; Soil Survey Division Staff, 2017).

Field color determinations (see [SOP-F400](#)) are affected by variable natural lighting, sun angle, and observer fatigue. This laboratory procedure standardizes the observation under a controlled illuminant to improve reproducibility and provide a reference-quality color record.

2. Scope

- **Applies to:** All soil and sediment samples for which a reference-quality Munsell color determination is needed, including both moist and air-dried conditions
- **Does not apply to:** Rock or mineral color determinations using the Munsell Rock Color Chart, instrumental colorimetry or spectrophotometry, or quick field assessments (which remain valuable but are less reproducible)
- **Location:** EA Program laboratory, SGM 133

3. Responsibilities

Role	Responsibility
Lab PI	Approve SOP, ensure training compliance
Trained Personnel	Perform color determinations, record results
New Students	Complete training before independent use

4. Definitions

- **Chroma:** The colorimetric purity or saturation of a color; the third component of Munsell notation (e.g., the 4 in 10YR 4/4); higher chroma values indicate more saturated, vivid colors; low chroma (less than or equal to 2) in subsurface horizons indicates gleying and periodic saturation.
- **Hue:** The dominant spectral color in Munsell notation (e.g., 10YR, 7.5YR, 2.5Y, Gley 1); corresponds to the wavelength of the dominant reflected light; the first element of a Munsell color designation.
- **Munsell color system:** A standardized color notation developed by A.H. Munsell expressing color as three independent components: Hue, Value, and Chroma; used universally in soil science for objective color description.
- **Redoximorphic features:** Color patterns in soil caused by reduction and oxidation of iron and manganese under fluctuating saturation conditions; include masses (concentrations), depletions (zones of low chroma), and concretions; diagnostic for hydric soils.
- **Standard illuminant (D65):** A standardized daylight spectrum at 6,500 K color temperature; the reference lighting condition for accurate Munsell color matching; overcast north-sky light or a D65 light box approximates this condition.
- **Value:** The lightness or darkness of a color in Munsell notation; ranges from 0 (black) to 10 (white); the second component in Munsell notation (e.g., the 4 in 10YR 4/4).

5. Safety and Hazards

Hazards

- **Biological:** Soil samples may contain pathogens. Wash hands after handling soil.
- **Physical:** No significant hazards. If using a spray bottle to moisten samples, avoid wetting electronic equipment or Munsell charts.

5.1. Required PPE

- ☐ Nitrile gloves
- ☐ Lab coat

6. Equipment and Materials

Item	Notes
Munsell Soil Color Charts (current edition)	Replace when pages are faded, stained, or damaged
Daylight-balanced lamp (D65 or equivalent, 5,000–6,500 K)	Position to illuminate the sample and chart evenly without glare
Spray bottle with deionized water	For moistening air-dried samples
White ceramic tile or neutral gray card	For calibrating eye to neutral
Spatula or palette knife	For preparing a smooth sample surface
Lab notebook or standardized data sheet	For recording results

7. Procedure

7.1. Lighting Setup

1. Position the daylight-balanced lamp so it illuminates the sample and the Munsell chart at approximately the same angle and distance
2. Avoid mixing light sources (turn off overhead fluorescent or LED room lights if their color temperature differs significantly from the reference lamp)
3. Allow the lamp to warm up for at least 5 minutes before beginning observations

Note

If a daylight-balanced lamp is not available, work near a north-facing window under overcast sky conditions. Avoid direct sunlight, which changes color temperature with sun angle and clouds.

7.2. Sample Preparation

1. For **moist** color: if the sample is already field-moist, proceed directly. If it has been air-dried, moisten a subsample by adding deionized water drop by drop with a spray bottle or pipette until the sample glistens but no free water pools on the surface (Soil Survey Division Staff, 2017)
2. For **dry** color: use the air-dried sample without adding water
3. Use a spatula to press the soil into a smooth, flat surface (approximately 2–3 cm diameter) on a white or neutral background. A rough surface creates shadows that bias the reading toward darker values.
4. If the sample is heterogeneous (e.g., redoximorphic features), determine the color of the matrix and the color of each distinct mottle or concentration separately

7.3. Color Determination

1. Hold the Munsell chart adjacent to the prepared sample so both are under the same illumination
2. Look through the apertures on the chart page, placing the sample behind each hole, to find the closest match
3. First identify the correct **hue** page (e.g., 10YR, 7.5YR, 2.5Y)
4. Then match the **value** (lightness, vertical axis) and **chroma** (saturation, horizontal axis) within that page
5. Record the Munsell notation in the format: hue value/chroma (e.g., 10YR 4/3)
6. If the sample falls between two chips, record the interpolated notation or the nearest chip with a note (e.g., “10YR 4/3 to 4/4”)
7. Repeat the determination for both moist and dry conditions

Tip

Color vision varies between individuals and can shift with fatigue. For critical determinations, have two observers independently determine the color and compare results. If readings differ by more than one chip in any dimension, re-examine jointly.

7.4. Recording Results

Record the following for each sample:

- Sample ID and depth
- Munsell notation (moist)
- Munsell notation (dry)
- Descriptive color name from the chart (e.g., “dark yellowish brown”)
- Any redoximorphic features (mottle color, abundance, size, contrast)
- Observer name(s)
- Date and lighting conditions

7.5. Special Cases

Redoximorphic features: When mottles or concentrations are present, record the matrix color and the color, abundance (few, common, many), size (fine, medium, coarse), and contrast (faint, distinct, prominent) of each type of feature per the standards in the Soil Survey Manual (Soil Survey Division Staff, 2017).

Very dark samples (value 2 or less): These may be difficult to distinguish on the chart. Prepare a thinner smear and confirm under slightly brighter illumination.

Effervescent or calcareous samples: Note the presence of carbonates (tested with dilute HCl per [SOP-L402](#)), as carbonate coatings affect apparent color.

8. Quality Control and Acceptance Criteria

- Perform duplicate readings (by the same or a second observer) on at least 10% of samples
- Acceptable agreement: readings should match within one chip in value and one chip in chroma on the same hue page
- Inspect the Munsell chart for fading or staining at the start of each session; replace if the neutral chip (N/) no longer appears true gray
- Record the lamp model and approximate color temperature in the lab notebook

9. Waste Disposal

Waste Type	Disposal Method
Used soil subsamples	Return to sample container or standard trash
No chemical waste generated	–

10. References

Lynn, W., & Pearson, M. J. (1993). Soil color, mineralogy, and classification. In J. M. Bigham & E. J. Ciolkosz (Eds.), *Soil color* (pp. 71–91). Soil Science Society of America. <https://doi.org/10.2136/sssaspecpub31.c5>

Soil Survey Division Staff. (2017). *Soil survey manual*. Government Printing Office. <https://www.nrcs.usda.gov/resources/guides-and-instructions/soil-survey-manual>

11. Training Record

Before performing Munsell color determinations independently, personnel must:

1. Read this SOP in full
2. Review the introductory pages of the Munsell Soil Color Charts

3. Practice matching at least 10 samples under supervision and compare readings with a trained observer
4. Demonstrate agreement within one chip in value and chroma on duplicate determinations
5. Be signed off by the PI or lab manager