

Ecological field methods badge

Content, skills, and behavioral attributes of the badge:

- Content: line transect and quadrat census; botanical morphospecies observation and identification; measure percent cover, density, species richness, relative abundance
- Skills: data collection, census plot establishment, morphospecies identification, graphical data representation, percent cover measurement, calculation of density, relative abundance, species richness, and diversity
- Behavior: time management, teamwork, decision-making

Overarching badge goals:

1. Students will implement field census plots (line transects and quadrats) and collect morphospecies identities and abundance using established field protocols.
2. Students will calculate and visually represent morphospecies richness, diversity, relative abundance, percent cover, and density using data collected in the field.
3. Students will complete field-based assessments of plant identities by making systematic observations of major morphological features, location, and habitat.
4. Students will make inferences about the impact of geologic, geomorphic, and/or hydrologic factors on the spatial distribution, diversity, and density of plants.

Rubric:

Field census plot data collection

Meets the standard	Does not meet the standard
Includes complete description of protocol used to collect data. AND Explicit written evidence is provided to indicate that selection of sample location and orientation was random to avoid sampling bias.	Written description of protocol used to collect data is incomplete. AND/OR Written description of protocol used to collect data is missing. AND/OR No written evidence to indicate random sampling. AND/OR Protocol write-up suggests sample bias.

Thoroughness and legibility

Exceeds the standard	Meets the standard	Does not meet the standard
95% or more of the product is complete. AND Product is legible to an evaluator.	75% or more of the product is complete. AND Product is legible to an evaluator.	Less than 75% of the product is complete. AND/OR Legibility problems hinder evaluation.

Botany product elements

Exceeds the standard	Meets the standard	Does not meet the standard
Product includes all required major and minor elements as specified in the project instructions. (See supplemental document.)	Product includes all required major elements as specified in the project instructions. (See supplemental document.) AND/OR 1 minor element missing.	Product is missing one or more required major elements as specified in the project instructions. (See supplemental document.) AND/OR Product is missing 2 or more required minor elements.

Product elements: botanical transects and quadrats

- date and location
- randomization procedure
- partner
- length of transect, if applicable
- size of quadrat, if applicable
- transect/quadrat position (crest, 30 m, etc.)
- recorded name and location of all plants in the specified width of transect

Systematic observations of plants

Exceeds the standard	Meets the standard	Does not meet the standard
Product includes all required elements of a botanical description as specified in the project instructions. AND Line drawing helps the reader identify the key morphological characteristics of the species. AND 95% or more of botanical description(s) utilize technical botanical terms that help the reader identify the key morphological characteristics of the species.	Product includes all required elements of a botanical description as specified in the project instructions. AND Line drawing helps the viewer identify the key morphological characteristics of the species. AND 75% or more of botanical description(s) utilize technical botanical terms that help the reader identify the key morphological characteristics of the species.	Product is missing one or more required elements of a botanical description as specified in the project instructions. AND/OR Line drawing does not effectively identify the key morphological characteristics of the species. AND/OR Fewer than 75% of botanical description(s) utilize technical botanical terms.

Product elements: botanical observation images

- line drawing of whole plant illustrating habitat
- line drawing of close-up of a leaf, if applicable
- line drawing of close-up of a flower/fruit/cone, if applicable

Product elements: botanical observation characteristics

- approximate latitude and longitude
- site name or nearby landmark
- habitat (grassland, forest, scrub, chaparral, etc.)
- important geologic, geomorphologic, and/or hydrologic features about the site, if applicable
- microhabitat noted (wet depression, windswept ridge, along a brook, etc.)
- habit
- stem and leaf morphology
- flower/fruit/cone morphology if present

Quantitative accuracy

Exceeds the standard	Meets the standard	Does not meet the standard
<p>If graph is required, axes are labeled correctly.</p> <p>AND</p> <p>Data are accurately depicted on the graph, if applicable.</p> <p>AND</p> <p>100% of calculations are correct for the following, if applicable: species richness; percent cover; density; Shannon's diversity index</p>	<p>If graph is required, axes are labeled correctly.</p> <p>AND</p> <p>Data are accurately depicted on the graph, if applicable.</p> <p>AND</p> <p>90-99% of calculations are correct for the following, if applicable: species richness; percent cover; density; Shannon's diversity index</p>	<p>If graph is required, axes are labeled incorrectly.</p> <p>OR</p> <p>If graph is required, axes are not labeled.</p> <p>AND/OR</p> <p>Data are not accurately depicted on the curve, if applicable.</p> <p>AND/OR</p> <p>Fewer than 90% of calculations are correct for the following, if applicable: species richness; percent cover; density; Shannon's diversity index</p>

Justification of interpretations

Exceeds the standard	Meets the standard	Does not meet the standard
<p>Analysis includes explicit references to field data.</p> <p>AND</p> <p>Variations among transects/quadrats are explicitly stated, referencing quantitative data collected.</p> <p>AND</p> <p>All interpretations are explicitly linked to field observations.</p> <p>AND</p> <p>Student proposes 2 or more impacts of geology, geomorphology, and/or hydrology on the spatial distribution and/or diversity and/or density of plants.</p> <p>AND</p> <p>Earth system impacts on botany are supported by specific geologic, geomorphologic, and/or hydrologic observations at the field site.</p>	<p>Analysis includes explicit references to field data.</p> <p>AND</p> <p>Variations among transects/quadrats are explicitly stated, referencing quantitative data collected.</p> <p>AND</p> <p>All interpretations are explicitly linked to field observations.</p> <p>AND</p> <p>Student proposes 1 impact of geology, geomorphology, and/or hydrology on the spatial distribution and/or diversity and/or density of plants.</p> <p>AND</p> <p>Earth system impact on botany are supported by specific geologic, geomorphologic, and/or hydrologic observations at the field site.</p>	<p>Analysis does not include explicit references to field data.</p> <p>AND/OR</p> <p>Variations among transects/quadrats are explicitly stated.</p> <p>AND/OR</p> <p>Interpretations are not explicitly linked to field observations.</p> <p>AND/OR</p> <p>Student does not make connections between the geologic, geomorphologic, and/or hydrologic characteristics of the field site and the spatial distribution and/or diversity and/or density of plants.</p>