

Geoscience educators teach in and by means of **places**: localities given meaning by human experiences in them.

The human connection to places is often described as a **sense of place** that combines emotional attachments and diverse intellectual meanings [1], and thus overlaps the affective and cognitive domains.

Physical and cultural environments alike directly influence sense of place [2]; if sense of place in turn influences how people observe, interpret, and understand nature, it is a factor in geoscience learning and teaching [3].

Among students with rich and sustained cultural ties to their homelands (e.g., American Indians and Mexican Americans in the Southwest US), sense of place may be seen as a kinship [4, 5]. Such students may be dissuaded by mainstream geoscience teaching that conflicts with their senses of place, the affective component in particular.

They may be better engaged by **place-based (PB)** teaching, which leverages senses of place of students and instructors. PB teaching is locally situated, provides authentic experiences, synthesizes scientific and cultural place meanings, and promotes environmental and cultural sustainability [3].

Characterization and measurement of sense of place are prerequisite to informed design, implementation, and assessment of PB geoscience curricula.

Deconstructing sense of place

Sense of place = **Place meaning*** + **Place Attachment**

Rich set of locally constructed and culturally moderated knowledge and skills (e.g., scientific knowledge of places) [6, 7]

→ = **Place Identity[†]** + **Place Dependence[†]** [8]
Emotional bonds to a place Capacity of a place to support goals or activities

*Characterized by ethnographic or other scientific methods; can be assessed quantitatively or qualitatively (e.g., as content knowledge).

[†]Characterized by ethnographic methods and measured by quantitative or qualitative psychometric instruments.

Resources and methods for research and design

Textual and graphic representations of places
Archived written and oral histories of places
Field studies and audiovisual documentation in places
Ethnographic interviews
Psychometric surveys

Important constraints

Human subjects protection
Cultural protection and preservation
Sources and authenticity of content
Statistical significance of measurements

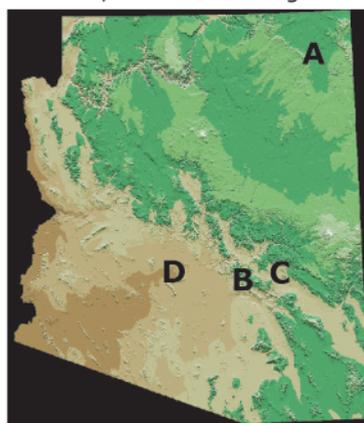
Places and regions where sense of place studies are sited

A: *Diné bikeyah (Navajo Nation)*, Colorado Plateau, AZ-NM-UT
Largest American Indian nation by population and land area.
Comparatively rich preservation of language and culture.

B: *Copper Triangle*, Basin and Range/Transition Zone, AZ
Geologically, historically, culturally diverse; Yavapai and Apache traditional homelands; Mexican-American mining communities. "Reborn" mining town of *Superior* is focus.

C: *San Carlos Apache Nation*, Transition Zone, AZ
Geological icon; culturally rich but academically isolated.

D: *ASU Tempe and Downtown Phoenix*, Basin and Range, AZ
Diverse ethnic, cultural, and linguistic mix of students, ESL; pre-service teachers; can PB teaching work in an urban area too?



References

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Research activities

Characterization and measurement of place attachment to Arizona in diverse groups [9]

Affective component of sense of place measured using a *Place Attachment Inventory (PAI)*, a valid, reliable, and generalizable [8] 12-item Likert-scale survey of place identity and place dependence. PAI administered to ASU intro geology students (n ~ 1400) and community members; compared to independent variables including home place, race, ethnicity, and gender.

Place attachment is measurably stronger for one's "home" whether or not one now resides there.
No significant variation in place attachment for Arizona by race or ethnicity among ASU students.
Variations in place attachment among non-student subjects are now being measured.

Affective versus cognitive outcomes of Southwest PB introductory geoscience teaching

Course design

Southwest PB alternatives to a mainstream ASU physical geology course were designed for the Diné tribal college [3, 10] and diverse large-enrollment sections (n = 30 and 220) at ASU [11, 12]. Course content was organized around Southwest landscapes, processes, and resources; and integrated Indigenous oral histories and geographies, ethnogeologic knowledge (as available), and excerpts from written and visual artworks.

Place attachment and place meaning as measures of course effectiveness

Does PB teaching leverage and enhance sense of place? PAI and a *Place Meaning Survey (PMS)*, a valid 30-item Likert-scale instrument adapted from a survey for park visitors [6] were administered as pre- and post-tests.

Students' place attachment and place meaning for Arizona increased significantly (p < 0.01) [11, 12]:

Place attachment increased from near-indifference to positive attachment.
Post-course place attachment for PB students was greater than that for ASU students in conventional courses.
Students developed richer and more diverse understanding of Arizona as a place during the course.

Qualitative surveys reported student enthusiasm for the PB focus among natives and newcomers alike.

Comparison with other affective and cognitive measures of effectiveness

Views about knowing and learning science: Views about Science Survey, a 50-item contrasting-alternatives ("folk" versus "expert" views of epistemology, methodology, validity, relevance, etc.) survey [13] was administered as a pre- and post-test.

Student attitudes about how science is done and taught were more characteristic of an expert perspective following completion of the PB course.

Geoscience content knowledge ("does a PB course really teach science?"): a valid 15-item subtest from the *Geoscience Content Inventory (GCI)* [14] was administered as a pre- and post-test.

GCI scores increased significantly (p < 0.01) from pre to post; post-test mean GCI score for PB students was higher than that reported for post-course geology students nationwide.

Students began the PB course with geoscience content knowledge equivalent to that of their peers nationwide, but on average finished with a significant improvement, and above that of their national peers.

Studies in progress: *Instrumentality* (belief that the PB course will be of benefit [15]) and *intrinsic motivation* [16].

Ethnographic action research within the PB courses

Experimental courses now include a weekly "learning community" in which attitudes toward place and pedagogy can be formatively tracked and cultural expertise shared.