

EARTH Cards
Ethnoecological Approaches Rooted in Traditional Hopi Knowledge

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Place-Based, Data-Rich, Culturally-Sustaining, Investigative STEM (CSIS)

2025

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Topic & Context

*“I want to be the very best
Like no one ever was
To catch them is my real test
To train them is my cause.”*

- Gotta Catch 'em All
(Dixon, Loeffler, & Siegler, 2017)

This line from the Pokémon theme song captures the spirit behind this project. Pokémon has become a familiar part of my students' world, from the video games and shows to the trading card game. The card game itself is built around strategy, collecting, and learning about each character's abilities (Steinmetz, 2016). During free time, I often see my students trading cards, building decks, and explaining powers with excitement and pride. That energy made me wonder—what if we created a similar kind of card, but one that helps them explore their own knowledge, culture, and family stories? That question sparked the idea for EARTH Cards, where students “catch” stories, traditions, and knowledge from their families and community and they “train” their science and math skills by measuring, observing, and making models based on what they learn. It's a way to mix what they love with what they need to learn, all connected to who they are.

This lyric from the Pokémon theme song captures the spirit of this project. Pokémon is a popular media franchise that includes video games, television shows, movies, and a trading card game. The Pokémon Trading Card Game involves strategic play using cards that represent characters, energy types, or trainers (Steinmetz, 2016). Many of my students enjoy playing with these cards during free time, which inspired me to explore how we might integrate Hopi culture into a similar card-based learning experience.

Ethnoecology, as described by Patrick (2020), looks at how different communities understand and interact with the natural world around them. For many Indigenous groups, including the Hopi, this relationship isn't just about using resources—it's about care, respect, and shared knowledge passed down over time. Castagno et al. (2021) explain that Indigenous knowledge systems and languages provide strong foundations for learning, helping students connect academic content to their cultural and ecological backgrounds.

The idea for the EARTH Cards came from watching how excited my students get when they trade and play with Pokémon cards. I wanted to take that same energy and build something more connected to who they are. So, instead of collecting fantasy creatures, they create cards based on local plants and animals that are meaningful in Hopi culture. We spend time listening to stories, talking with family members, and learning how these plants and animals are part of everyday life and tradition through storytelling and ethnoecological study. They gather information by interviewing family members or community elders, blending traditional knowledge with scientific facts. As part of the project, students measure things like leaves or seeds from the plants they study. We use those measurements to create line plots using fractions, aligning with Arizona Math Standard 5.MD.B.2. In science, we talk about how everything in nature is connected, how energy moves through plants, animals, and decomposers. The students create simple models to show these

systems, using both what they've learned in class and what they've heard from their families., They then develop models showing how matter moves among plants, animals, decomposers, and the environment, addressing NGSS 5.L1U1.4. Finally, they design their own collectible EARTH Cards, combining artwork, cultural knowledge, scientific information, and "powers" that reflect the significance of their chosen organisms. The unit ends with students sharing their cards with peers, families, and the school community, building connections between culture, science, and personal identity.

This unit is designed for a small, close-knit 5th-grade class of seven students, most of whom identify as Hopi or have mixed Hopi-Navajo heritage. These students are strong in math and reading, but science instruction is limited to 45 minutes each week. This restricts opportunities for deeper exploration, even though a summative science assessment is required at the end of the year. My students are curious and excited about science, but the lack of hands-on activities slows their progress. This unit helps bridge that gap by combining science with math skills, connecting to Arizona 5th Grade Math and Next Generation Science Standards.

The EARTH Cards project is well-suited for the spring semester, when local ceremonial events bring families together to share stories. This timing supports culturally sustaining practices and creates a meaningful setting for students to explore science alongside their cultural identity. It also supplements limited classroom science instruction with hands-on, meaningful learning that blends multiple content areas. Assessment will include evaluating students' line plots and models for accuracy, creativity, and cultural relevance in their EARTH Card designs, as well as their ability to present and explain their cards to others. This approach allows me to assess understanding of both science content and cultural knowledge.

With this hands-on, culturally grounded unit, students gain a stronger connection to science while honoring their heritage. It encourages curiosity, supports identity, and makes science more accessible and meaningful. As Robin Wall Kimmerer writes, ***"In a culture of gratitude, nothing is done in isolation. The gift is passed from hand to hand and grows as it is shared."*** This project is a gift from the students' families and ancestors, reimagined through science and passed on through learning.

Rationale

“A Hopi... is one who fulfills the meaning of *Sumi'nangwa* by coming together to do activities for the benefit of all, out of a compelling desire and commitment to contribute or return something of value or benefit to the society.”

- Qöyahongniwa, Songoopavi (1995)

This project began with a moment that stayed with me. During our clan race, I looked up and saw birds dancing above us. My students were gathering flowers and plants along the trail, and it made me curious. I asked them what some of the plants were and what they were used for. A few had answers, some were not sure, and I realized I did not know either. That small moment stayed with me. It made me wonder how we could turn that curiosity into something meaningful, something they would remember.

My students love Pokémon cards. They know every name, power, and detail by heart. They trade them, talk about them, and take pride in their collections. I wanted to take that same energy and root it in their own lives. That is how the idea for EARTH Cards was born. What if they could create cards based on local plants or animals? What if those cards told family stories, shared cultural knowledge, and included real science data they collected? What if they could draw the images and choose their own symbols?

The goal is to help them become more aware of what is around them and to see themselves as part of something larger: their families, their communities, and the land. This reflects what Castagno, Joseph, and Dass (2021) describe as encouraging students to understand themselves within broader communities, building and sustaining relationships, and strengthening classroom connections. Through EARTH Cards, students learn that their knowledge and stories matter, and that they are connected to the plants, animals, and people who share their environment.

This project also brings traditional knowledge into the classroom, honoring local norms, values, and interests (Castagno et al., 2021). By interviewing parents and elders, students learn how plants are used, what memories are tied to them, and how families care for the environment over time. These conversations turn into lasting artifacts, cards that combine cultural stories, science data, and student-created artwork. This process reflects Indigenous knowledge systems and validates them as a source of learning while also building academic language in science and math without displacing local language or ways of knowing.

I want my students to feel confident in science, which can be hard when instructional time is limited, and the focus is often on English Language Arts and Math. Many of my students are visual thinkers, storytellers, and artists. This project gives them space to use those strengths while practicing data collection, modeling, and scientific explanation. It also encourages them to exercise self-determination and agency as they choose which plants or animals to study and how to represent them (Castagno et al., 2021). The science component is aligned with NGSS 5.L1U1.4, which asks students to develop models to describe how matter moves among plants, animals, decomposers, and the environment. The math connection supports Arizona Math Standard 5.MD.B.2 through creating and interpreting line plots based on their own measurement data.

I am not from here, and I still have a lot to learn. I bring a background in science and formal education, but my understanding of Hopi culture and language is still developing. That is why I try to weave local knowledge into what we do and participate in cultural events when I can. My students and their families have been my teachers in many ways. They are the experts in their own stories and contexts, and they help me grow my understanding of the history, language, and cultural practices of this place. I try to approach this work with respect, openness, and a willingness to listen.

Families here are generous and deeply involved. They care about their children and are quick to support anything that reflects who their kids are. This unit gives students a chance to share something meaningful, work alongside their families, and feel proud of what they create. Representation is important. Students see their culture reflected in a contemporary, living way, not just as something historical (Castagno et al., 2021). They see that the knowledge they carry is valuable for school and for their future.

One student told me after interviewing his grandmother, “I did not know that plant was used in our ceremonies. I thought it was just a weed.” That moment captures exactly what this project is about. It is about helping students notice what has always been there, challenging assumptions, and learning through curiosity, connection, and culture. The EARTH Cards project affirms that Indigenous knowledge is living, diverse, and powerful, and it reminds students that what they notice, what they wonder about, and what they share matters.

Instructional Guide

The *EARTH Cards: Catching Stories, Training Minds* unit invites my fifth graders in Moenkopi to study local plants and animals and share what they learn through collectible cards that weave science, math, art, and family knowledge. The purpose is simple and clear. I want students to see that science lives in the places and people they know, and that careful observation, measurement, and modeling can sit alongside stories and names they hear at home. The unit focuses on nearby flora and fauna, Hopi and scientific naming, measurement and graphing with line plots, and models that explain how matter moves among plants, animals, decomposers, and the environment. It is designed for a setting where science time is tight, and students benefit from work that feels local and hands-on.

One classroom moment shaped how I teach this. After I returned from being sick, a student brought herbs from her grandmother. Neither of us knew how to use them, so I asked her to interview her grandmother and report back. She came in the next day, eager to share the plant’s name and purpose, and her curiosity grew from there. That experience reminded me that family knowledge can open the door to science learning, especially when students see their homes and community as part of what “counts” in school.

The unit runs for five lessons, one day for each letter in the EARTH acrostic. On Day 1, students explore local life by observing plants and animals around Moenkopi, sketching details, and asking questions. On Day 2, they ask their family to share stories by interviewing a parent, grandparent,

or elder about names, uses, memories, and care practices linked to a chosen organism. On Day 3 they record names, uses, and meanings by bringing Hopi and scientific names together, taking simple measurements such as leaf lengths or seed counts, and creating line plots in line with Arizona Math Standard 5.MD.B.2. On Day 4 they turn it into a card by designing an EARTH Card that includes an illustration, both naming systems, measured data, and a short explanation of cultural and ecological significance. On Day 5, they honor their knowledge by sharing, presenting cards to classmates, younger grades, and families, and then reflecting on what they learned.

Instruction relies on project-based learning and active science practices. Research shows that when students work on meaningful projects with real audiences, motivation and conceptual understanding improve (Krajcik & Shin, 2014; National Research Council, 2012). Lessons begin with a brief modeling of a skill, such as accurate measuring or how to set up a line plot. Students then work with a partner to rehearse interview questions or compare findings, followed by independent design time where artists and writers can shine. I use Think-Pair-Share and simple Kagan structures for low-risk talk. Shy students write first, then read from their notes when they share. This mix of modeling, collaboration, and creation supports science learning and language growth, especially when content is grounded in familiar contexts (Lee & Buxton, 2013).

Assessment is steady and visible. Formative checks include quick writes, exit slips, and brief student-led reflections after observation walks or family interviews. Summative work includes three products. First, line plots and data tables are checked for accuracy and clear labels. Second, students create models that show how matter moves among organisms and the environment, which addresses NGSS 5.L1U1.4. Third, the EARTH Card and short presentation are scored with a rubric that values scientific accuracy, respectful use of cultural knowledge, clarity, and creativity. These choices reflect guidance to assess in ways that honor community knowledge and relationships, not only written tests (Castagno, Joseph, & Dass, 2021).

Culturally sustaining moves are woven throughout. Students study organisms that matter to their families, treat elders as knowledge holders, and see Hopi naming and uses alongside scientific language. This aligns with work that invites Indigenous ways of knowing into science learning and treats them as sources of explanation, not add-ons (Bang, Warren, Rosebery, & Medin, 2012). The topics are local and practical, which supports problem- and community-focused science (Buxton, 2010). Students choose which organism to study and how to represent it, which supports agency and self-determination. Displaying cards for peers and families builds pride and keeps relationships at the center of the work, consistent with the CRAIS Tool principles of relationality, Indigenous knowledge systems, representation, and classroom relationships (Castagno et al., 2021).

My goal is that *EARTH Cards* make science feel close to home. Students practice measuring and modeling while naming what they see in their own words and in the words of their families. They learn to speak as scientists and as community members, and they leave evidence of their learning in a form they are proud to share.

TEACHING PLAN

EARTH Cards: Ethnoecological Approaches Rooted in Traditional Hopi Knowledge

This five-day unit connects Hopi cultural knowledge, scientific investigation, and artistic expression. Students interview family members about plants or animals that hold cultural importance, collect data, and apply scientific reasoning to create *EARTH Cards*—collectible cards that blend **Ethnoecology, Art, and STEM**.

Each lesson follows one letter of the acronym **E.A.R.T.H.** (Explore, Ask, Record, Turn, Honor) and emphasizes collaboration, critical thinking, and culturally sustaining practices. The sequence is designed to honor both traditional ecological knowledge and academic science, showing students that learning happens through observation, inquiry, and storytelling.

- Day 1: **Explore Local Life**, uses the 5E Inquiry Model to build curiosity and observation skills as students explore the land around their school. During RallyRobin, partners take turns sharing what they noticed, encouraging equal participation and attentive listening.
- Day 2: **Ask Family to Share Stories**, applies the Project-Based Learning Cycle to connect classroom learning with home knowledge. Students develop interview questions and practice active listening through Think-Pair-Share, preparing to gather oral histories from their families about plants and animals important to Hopi culture.
- Day 3: **Record Names, Uses, and Meanings**, follows a Cooperative Learning and Jigsaw format. Students measure and graph real data using line plots that meet Arizona Math Standard 5.MD.B.2. Using Numbered Heads Together, small groups work collaboratively to interpret their findings and compare Hopi and scientific names, reinforcing teamwork and accountability.
- Day 4: **Turn It into a Card**, incorporates Design Thinking to merge creativity with scientific reasoning. Students design their own EARTH Cards that showcase both ecological and cultural information. The RallyCoach structure allows partners to alternate roles as creator and coach, offering feedback and refining their work together.
- Day 5: **Honor Your Knowledge by Sharing**, concludes with a Socratic Seminar and Reflection Circle that celebrates student learning and family contributions. Using Quiz-Quiz-Trade, students exchange cards and quiz one another, reinforcing new knowledge in a fun, interactive way. This final day highlights relationality and representation as students present their cards to peers, younger grades, and families.

Each lesson purposefully blends inquiry, art, mathematics, and storytelling to strengthen academic and cultural connections. Guided by the **CRAIS Tool principles**—relationality, Indigenous knowledge systems, representation, and self-determination—students learn to value their own community as a source of scientific understanding. By the end of the unit, they see themselves not only as learners, but as scientists, artists, and knowledge keepers who honor the wisdom of their land and families.

Day 1 Explore Local Life

Observation and Inquiry through Local Ecology
using 5Es – Engage, Explore, Explain, Elaborate, and Evaluate

“**Explore Local Life**” follows the 5E Inquiry Model to guide students through observation, questioning, and curiosity-driven discovery. Students take a nature walk to record observations of local plants and animals, sketching details in their journals. The RallyRobin Kagan structure allows partners to take turns sharing what they noticed, ensuring that every student’s ideas are valued and heard.

I. Standards:

NGSS 3–5.SEP.1 – Ask questions and define problems.

CRAIS Principle: *Relationality* – encourages students to understand themselves within broader communities.

II. Learning Objectives:

- observe and describe local plants and animals found around the community
- generate inquiry questions about living things in the environment

III. Instructional Sequence:

- Engage (10 min):** Begin with a short video or slideshow of local plants, animals, and seasonal Hopi events (e.g., planting or harvest scenes). Ask: “What do you notice? What do you wonder?”
- Explore (20 min):** Take students on a nature walk around the school grounds or nearby area. Students record observations using journals and magnifiers, sketch what they see, and label any species they know.
- Explain (10 min):** Back in class, students share discoveries using **Kagan: RallyRobin**, taking turns describing one thing they noticed.
- Elaborate (10 min):** Class creates a community “Observation Wall” — a chart of all species or natural features identified. Students use colored sticky notes to mark which ones are familiar from home or family stories.
- Evaluate (10 min):** Exit ticket — write one thing they learned and one question they want to explore further.

IV. Materials: Clipboards, magnifiers, journals, sticky notes, chart paper, markers

V. Assessment:

- Observation journals (sketch + 3 details)
- Exit ticket: “I wonder...” question
- Teacher checklist for participation and inquiry quality

Day 2 Ask Family to Share Stories

Family Interview and Oral History Integration using Project-Based Learning Cycle

“Ask Family to Share Stories” uses the Project-Based Learning Cycle (Launch, Investigate, Create, Share) to bridge classroom learning with home knowledge. Students prepare interview questions and practice active listening through Think-Pair-Share, a cooperative Kagan structure that strengthens speaking and listening skills before students conduct their real interviews with family members.

I. Standards:

AZ ELA 5.SL.1 – Engage effectively in collaborative discussions.

CRAIS Principle: *Indigenous Knowledge Systems* – includes traditional and cultural knowledge.

II. Learning Objectives:

- develop interview questions that respectfully elicit traditional and ecological knowledge.
- interview with a family or community member to gather information about a culturally significant plant or animal.

III. Instructional Sequence:

- Launch (10 min):** Discuss how storytelling and oral knowledge preserve traditions. Read aloud a short Hopi story or quote about plants and community.
- Investigate (15 min):** Model an interview using a student volunteer while the class observes what makes the questions effective (eye contact, tone, follow-up questions).
- Kagan Structure – Think-Pair-Share (15 min):** Students pair up to practice asking sample interview questions and receive peer feedback.
- Create (10 min):** Students finalize their 10-question interview sheet and plan who they will talk to at home.
- Share (5 min):** Whole-class closing discussion: “How can we show respect when collecting knowledge from our elders?”

IV. Materials: Interview form, Hopi-English chart, pencils, and optional recording device.

V. Assessment:

- Completed interview plan (teacher feedback on question quality).
- Summative: Family interview sheet, due the next day.
- Criteria: respectful language, complete details, clear connections to cultural use.

Day 3 Record Names, Uses, and Meanings

Measurement, Graphing, and Connecting Cultural and Scientific Language
using Cooperative Learning (Kagan + Jigsaw for Data Sharing)

“**Record Names, Uses, and Meanings**” uses Cooperative Learning and Jigsaw methods to integrate data collection and mathematical reasoning. Students measure plant parts or natural objects, create line plots aligned with Arizona Math Standard 5.MD.B.2, and compare Hopi and scientific names. The Numbered Heads Together Kagan structure promotes accountability within small groups, as each student contributes to group accuracy and analysis.

I. Standards:

AZ Math 5.MD.B.2 – Make a line plot to display data sets using fractions of a unit.

CRAIS Principle: Representation – Indigenous and scientific languages are equally valued.

II. Learning Objectives:

- measure and record data accurately using standard tools.
- organize and represent data through line plots.
- compare Hopi and scientific names for clarity and understanding.

III. Instructional Sequence:

- Mini-Lesson (10 min):** Teacher models how to measure a leaf and record data with correct units. Discuss why accurate measurement matters in science.
- Kagan Structure – Numbered Heads Together (20 min):** In small groups, students measure various plant parts or small objects (e.g., leaves, seeds) and record the data. Each team collaborates, and one “number” from each group shares their results aloud.
- Create (15 min):** Students transfer measurements into a line plot, labeling axes and using fractional units.
- Jigsaw (10 min):** Groups exchange data with others and interpret each other’s line plots, identifying trends or outliers.
- Wrap-Up (5 min):** Students record one math or science insight from another group.

IV. Materials: Rulers, scales, data tables, graph paper, colored pencils.

V. Assessment:

- Line plot with correct labels and units.
- Reflection: “What does your data tell you about your organism?”
- Teacher checklist for measurement accuracy.

Day 4 Turn It into a Card

Design and Creation of the EARTH Card
using Design Thinking (Empathize–Define–Ideate–Prototype–Share)

“**Turn It into a Card,**” follows the Design Thinking process—Empathize, Define, Ideate, Prototype, and Share—where students synthesize science and culture through art. They design their own EARTH Cards that include measurements, scientific and Hopi names, cultural uses, and unique “powers” based on real ecological functions. The RallyCoach structure encourages partners to alternate roles as designer and coach, supporting creativity, precision, and collaboration.

I. Standards:

NGSS 5.L1U1.4 – Model how matter moves among plants, animals, decomposers, and the environment.

CRAIS Principle: *Self-Determination and Agency* – students make creative decisions reflecting their identity.

II. Learning Objectives:

- integrate scientific data, cultural information, and art into a cohesive product.
- design and produce an EARTH Card that communicates meaning and purpose.

III. Instructional Sequence:

- Empathize (10 min):** Students share what they learned from interviews and data collection. Discuss how their plant/animal helps the community and environment.
- Define (10 min):** Students list the key facts, stories, and measurements they will include.
- Ideate (10 min):** Brainstorm creative “power” or function based on the organism’s real traits (e.g., “Heals,” “Survives Heat,” “Pollinates”).
- Kagan Structure – RallyCoach (20 min):** Students take turns sketching their card layout while their partner observes and gives constructive feedback. Then they switch roles.
- Prototype (20 min):** Begin designing the EARTH Card (Hopi and scientific names, picture, measurement data, story, and power).

IV. Materials: Card templates, art materials, reference sheets, and sample cards.

V. Assessment:

- Formative: Draft EARTH Card (teacher and peer feedback).
- Summative: Final Card scored with rubric (scientific accuracy, cultural respect, creativity, organization).

Day 5 Honor Your Knowledge by Sharing

Presentation, Reflection, and Celebration using Socratic Seminar and Reflection Circle

“**Honor Your Knowledge by Sharing**,” concludes the unit with a Socratic Seminar and Reflection Circle that brings family, peers, and community together. Students present their cards and stories, exchange them using the Quiz-Quiz-Trade Kagan structure, and engage in reflective dialogue about what they learned from their families. This final day embodies relationality and representation, the principles at the heart of culturally sustaining science education, by celebrating knowledge as a shared gift rather than an individual achievement.

I. Standards:

AZ ELA 5.SL.4 – Present information clearly with appropriate expression

CRAIS Principle: *Relationality and Representation* build community through shared knowledge.

II. Learning Objectives:

- Present EARTH Card findings clearly and respectfully to peers and the community
- reflect on learning about family, science, and self

III. Instructional Sequence:

- Opening Circle (10 min):** Gratitude acknowledgment to families for their knowledge and support.
- Presentation Showcase (30 min):** Students share their EARTH Cards in a Socratic-style circle.
- Kagan Structure – Quiz-Quiz-Trade (15 min):** After each presentation, students exchange cards and quiz one another on the facts (Hopi name, use, scientific name). This keeps the audience engaged and builds cross-learning.
- Reflection Circle (15 min):** Students respond in writing:
 - “What did you learn about your family?”
 - “What did you learn about the land?”
 - “How can we honor what we learned?”
- Closing (10 min):** Students and guests sign a “Wall of Gratitude” for the knowledge shared.

IV. Materials: Display boards, reflection journals, feedback cards, and markers.

V. Assessment:

- Presentation Rubric (clarity, confidence, connection).
- Reflection paragraph scored for thoughtfulness and insight.
- Audience feedback cards collected and returned to presenters.

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