Junior Naturalists Curriculum and Analysis:
Wonder, Discovery, and Community on the Trails of Kitsap County Parks

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Purpose

The purpose of this project is to create an outdoor science curriculum fueled by students' questions and connection to place. This curriculum is adaptable to any outdoor space but is intended to be taught in the same place each lesson. This four-part series creates wonder and belonging by helping students connect to the natural world through social, historical, and ecological contexts. By exploring who has stewarded this land in the past, who stewards the land in the present, and who will steward the land in the future, students build an understanding that the forest depends on humans just as we depend on the forest. Highlighting this reciprocal relationship helps grow a sense of belonging in the natural world.

This 4-week curriculum helps students develop their identity as a naturalist while they learn to observe the ecosystem, identify flora and fauna, explore natural cycles, and understand interconnections of the natural world, including their own place within it. By empowering students to ask questions and follow their curiosity, educators give them agency to develop the tools to learn and answer questions. They accomplish this learning in a consistent community of peer scientists, led by an experienced instructor that facilitates team building and shared learning.

The goals of this project are to:

1. Help students connect to the natural world through social, historical, and ecological contexts.
2. Connect students and their families to public forests and trails in their community.
3. Build students identity as a naturalist so that they see themselves as both a science learner and teacher.
4. Create community safely outdoors during a global pandemic.

Rationale

The curriculum for my current project (Appendix A) is designed to connect young people to the natural world and help them discover their identity as a naturalist. It was written to pilot a new program called Junior Naturalists for Wild Society; an outdoor education non-profit located on the Kitsap peninsula in Western Washington.

The mission of the organization is to cultivate wonder and belonging in the natural world. They do this through hands on science learning at afterschool programs, on backpacking adventures, and at community events. Junior Naturalists is an afterschool program that creates a platform for students to engage in hands-on learning outside. The curriculum guides students in understanding what a naturalist is and builds their identity as a teacher and learner in a local park, which is a crucial step in becoming a caretaker of the land and public space in their communities. We must give our youth the opportunity to connect with the natural world.

Returning to the same park four times is a unique experience for students. Often, outdoor education experiences are a singular event in the form of field trips are intentionally located outside of the students' community. Junior Naturalists is hosted at a park a short distance from where they live, go to school, and engage in their community. This helps students see the green space in their community as a classroom and public land as an extension of their backyard to explore.

Junior Naturalists is a four-week program located on public Kitsap County land at North Kitsap Heritage Park and Newberry Hill Heritage Park. Groups of four students led by one instructor explore the trails of the same park for three hours each week. Instructors implemented this curriculum after completing a staff training and were required to teach the main lesson each week. This program was adapted and created during the Covid-19 pandemic, which limited the

type of activities, group size, length of programs, and location. Our permit with Kitsap County Parks limited group size to 5 people and students were required to wear masks, social distance, and wash their hands often. Students could not share materials or physically collaborate on projects.

Literature Review

There are several frameworks, curriculums and educational theorists that went into building the curriculum for this project. Along with the many experiences I have had as an outdoor educator, there are inspirational authors and educators that have driven my thinking and teaching.

The curriculum is written with the learner at the center. Learner-centeredness ideology constructs a curriculum around the "experience, interest, and development of individual learners" (Deng, 2015, p. 82). The Junior Naturalists curriculum embodies this by giving the student choices during each lesson in what and how they explore. Each lesson provides students the freedom to explore their surroundings and interact with the natural world by following their individual curiosity, while maintaining structured and specific learning objectives. Students get to choose what they journal about, which species to compare, what to draw in their watershed model, and how to construct their ecosystem maps. This kind of academic freedom gives space for creativity and growth.

It also allows for the lesson to meet students where they are at and encourages them to include knowledge that they already hold. This lends well to the structure of the program and the Wild Society philosophy that student groups should be mixed ages. It is unique for a program to have 9-year-olds and 12-year-olds learning together, but there is value in learning with students who are not the exact same age. The intellectual development can differ between a 9-year-old

and a 12-year-old, but student-centered education allows students of different ages to learn together without feeling ahead or behind.

Another curriculum that puts the student at the center is The BEETLES Project, which stands for Better Environmental Education, Teaching, Learning & Expertise Sharing. The Junior Naturalists curriculum was inspired by their pedagogical framework which states that "all students deserve consistent opportunities to develop environmental literacy and build meaningful connections to nature by participating in educational programs, spending time in wild spaces, and connecting to the natural places within their own communities" (The BEETLES Project). The curriculum I wrote for my project is grounded in connecting students to local parks in their communities. This aligns with the BEETLES philosophy and the Wild Society (2013) mission of "cultivating wonder and belonging in the natural world" by grounding students in the green spaces in their communities. By creating outdoor classrooms in local public parks, we are communicating to students and their families that their communities are embedded in a greater ecosystem and that they are members of that ecological web.

One of the goals of the Junior Naturalists curriculum is to grow students' identities as naturalists by "[empowering them] to use tools and practices of science to explore, wonder, connect to, and think about nature wherever there's a patch of green in their world" (The BEETLES Project). By incorporating time for wonder and discovery in each lesson, students can practice tools of observation and scientific inquiry. Practicing wonder and observation helps students develop the tools to answer questions and think like a scientist.

With a foundation of question asking and wonder, the Junior Naturalist curriculum pushes back against the banking concept that dominates the modern school system (Freire, 1970). In the banking concept, the teacher deposits knowledge into the learner, "projecting an

absolute ignorance onto others, a characteristic of the ideology of oppression," ignoring the prior knowledge that students bring to the classroom (Freire, 970, p.58). This mentality "negates education and the knowledge as process of inquiry" by discouraging students to ask questions and build on what they already now (Freire, 1970, p.58). Instead, the Junior Naturalists curriculum embraces inquiry and problem posing education. This allows the clear distinctions between teacher and student to be blurred as "they become jointly responsible for a process in which all grow" (Freire, 1970, p. 67). This can be accomplished by utilizing a students' funds of knowledge.

Students bring prior knowledge into a learning space that educators can build upon. Each person has an existing base of knowledge because "from birth one is socialized by others into particular cultural practices, including ways of using language(s) and ways of using artifacts that become the 'tools for thinking' through which we interact with our social worlds" (Amanti, Gonzales, Moll, p.18, 2009). By inviting individual backgrounds instead of ignoring them, educators are using existing tools of thinking and ways of knowing. Luis Moll explains that "understanding families and their cultural resources also includes raising possibilities for changes in classroom practice" (Amanti, Gonzales, Moll, p.19, 2009). Allowing students to differentiate their thinking and ways of understanding helps build robust discussion and sense making. Educators help this process by humbling themselves to become both teacher and student.

As the teacher becomes the student, and the students can become the teachers, it creates a learning environment where everyone is both a knowledge holder and a learner. In an "engaged pedagogy" (hooks, 1994), power can be given back to the students when educators acknowledge that they are learners too. Hook suggests that learning spaces where the teacher "employs a

holistic model of learning will also be a place where teachers grow and are empowered by the process" (hooks, 1994, p.21). The educators at Junior Naturalists were encouraged to learn alongside their students and admit to not knowing all the answers. Developing an identity as a teacher and a knowledge holder helps students identify as a naturalist.

A holistic model of teaching supports teachers in being culturally responsive. Zaretta Hammond, an educational theorist who influenced my curriculum, lays out five strategies for culturally responsive teaching in her book *Culturally Responsive teaching and the Brain* (2015). This curriculum leans heavily on three of these practices to help students feel included, empowered, and important by building relationships, creating a community of learning, and utilizing movement for learning.

The first culturally responsive teaching practice this curriculum strives to include is the practice of "building authentic relationships" (Hammond, 2015, p.20). The Junior Naturalists program did this through practicing gratitude and giving space for students to talk about their lives outside the program. Each day, students centered themselves in a gratitude circle by sharing with their peers what they were grateful for in that moment. It helped set a positive tone for the day and build relationships on a foundation of gratitude and hope. This project took place during a global pandemic and students shared their struggles of isolation and boredom due to online school. Students walked away from this program with new friendships and an understanding of a shared struggle during a difficult time because instructors left space to have those conversations and develop those relationships.

By putting intention into building relationships, we "created a community of learners" (Hammond, 2015, p.20). Educators can leverage the collaborative nature of students by working together to answer questions, using resources to learn together, and removing the teacher as the

main knowledge holder. Students were encouraged collaborate on projects and learn from each other. This also aided in developing their identities as naturalists by giving them the confidence to contribute to the group and share what they know.

The Junior Naturalists program "uses the brain's memory systems for deeper learning" (Hammond, 2015, p.20). This program does an excellent job incorporating movement and visuals as students are hiking through the forest examining natural phenomena. This provides improved neural pathways so that students better remember their learning experience.

Procedure

This Junior Naturalists curriculum (Appendix A) is structured to work with the 4-week schedule of the after-school program. There are four themes with an accompanying main lesson that is taught off trail in an open space chosen by the instructor. The themes and learning goals build on each other to culminate in the week 4 lesson. The supplemental activities, games, and walk/talk questions are intended to support instructors in rounding out their day and connecting to the main lesson. Instructors are encouraged to add supplemental activities and games to tailor the session to their strengths.

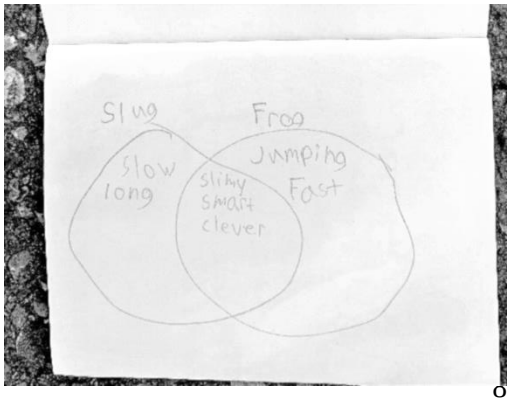
Each lesson is composed of 4 main sections, Explore, Investigate, Research, and Wonder. The explore phase is the hook of the lesson, giving students a chance to interact with a phenomenon in the forest. It typically incorporates free explore time with some guiding questions. The Investigate phase encourages the students to take their exploration a little deeper, sometimes using their journal to start recording observations and questions. The research phase examines those observations to build understanding of a new concept, make a model, or draw

conclusions. The Wonder phase includes a time for personal reflection and group discussion. The goal is for the students to walk away with more questions than they started with, but feel equipped with the tools to seek answers, giving them agency to be the driver of their own learning.

The first lesson is called "Nature Journaling" under the theme of Observing Our Ecosystem. Students focus on making informative observations about their surroundings and asking questions. The lesson focuses on using the five senses, cultivating wonder, and orienting them to using their journal. In the explore phase, students are given time to explore their surroundings. As they discover different parts of the ecosystem, the instructor prompts them to think about the questions "What do you notice? What do you wonder? What does it remind you of?" (The BEETLES Project). Students choose one natural object they find interesting to share with the group.

Students are asked to share three things they wonder about the object and to write at least two of those questions down in their journal. During the research portion of the lesson, students spend 15 minutes drawing the object and writing 5 things they notice or know about their object. Students then present their findings to the group to practice how naturalists share knowledge and wonder. The lesson wraps up by revisiting their original wonderings to see if they answered them through observation and to write two more questions they still have.

The second week's lesson is called "Bugs, Bugs, Bugs" under the theme of Flora and Fauna. Students explore the concept of ecological niches and why species look and act the way they do. Students use their skills of observation and journaling to dive deeper into



species comparisons. The explore phase of the lesson gives students time to look for and catch bugs and critters, prompting them to look at multiple levels and in less obvious places. Students are asked to choose three critters, either individually or collectively, to investigate.

Using their skills from week one, students continue to practice their observational skills and understand some new science ideas. Students sketch each critter, this time including details of habitat, food, and survival mechanisms. Students are encouraged to share knowledge they hold about different species and use context clues about their organism. The instructor takes time to explain what an ecological niche is, using the students' observations as examples. Students then choose two critters to compare using a Venn Diagram. The comparison helps the instructor introduce new vocabulary words or for students to use words they already know, such as competition, predation, mutualism, and commensalism. As students recognize the overlap and interactions of their organisms, they can use these words to explain the relationships. The lesson ends with a discussion of what their niche is and how they survive in it.

During the third week of the program, the lesson is called "Waterworks" under the theme of Cycles. Students explore what a watershed is through a hands-on relief map making project. Students explore how water interacts with the natural world and moves through a landscape. Students drew a map on crinkled paper to include many components of a community, such as roads, houses, parks, rivers, schools, factories, farms, and more. After identifying any potential pollutants as a group, the instructor sprayed water to the maps to see how the runoff moved through the relief map landscape. Students are then asked to build a map out soil and other natural objects, translating the paper relief map to earth. Students can

make changes to their map after seeing how the water interacted with the paper landscape.

The last week the lesson is called “Ecosystem Maps” under the theme of Interconnections. Students observe both biotic and abiotic aspects to build a map of the ecosystem. Students draw or write observations on a poster and then make connecting lines with statements or questions. Students use knowledge from previous weeks to make observations, compare organisms, consider niches, think about the landscape, and connect living and nonliving organisms. In the final week of the program, the students also complete an ecosystem map as evidence of their learning. These maps show where and how students are understanding ecological interconnections. This helps students understand the complex relationship between the biotic and abiotic world by thinking beyond living connections. It takes a different kind of thinking to connect a rock to a tree than a bug to a plant.

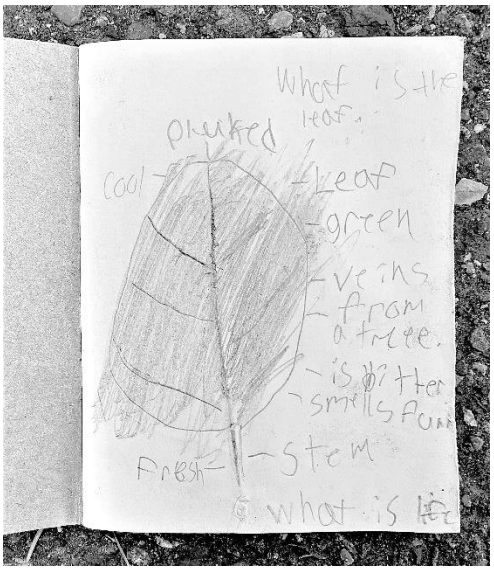
Students use journals issued by the Junior Naturalists program to complete the activities. During the first and last weeks of the program, students answer three questions in their journal:

1. How are you connected to this place?
2. Who is a naturalist?
3. What is a naturalist?

As students explore these questions, we can better understand how the program affected their learning. Comparing their answers from week 1 to week 4 can show how their thinking might have changed in what they think a naturalist is, who they think a naturalist is, and how they feel connected to a park in their community.

Analysis of Procedures

Students attend Junior Naturalists each week for a month. This gave instructors a total of 12 hours with students. Some students missed 1 or 2 days of programming for various reasons, but the majority of students were able to attend for the entirety of the session.



The first lesson on nature journaling was an opportunity to see what students already knew, assess their writing and drawing skills, and encourage building a relationship with their journal. Students' affinity for the journals varied across individuals. Explicitly framing the journals as a tool to practice observation, ask questions, and build knowledge helped students understand why and how to use them. Instructors explained that naturalists use nature journals to practice observation and record what they see and learn. Students understood that the journals would be collected each week so that instructors could look at the entries and give feedback.

Students practiced observation by noticing their surroundings and asking questions. It was the instructors' job to probe their thinking and help draw out ideas. Instructors worked to elicit ideas both in conversations and on paper by asking students to share what they know, expand on their answers, and build on each other's knowledge. For some students, this meant challenging them to add more observations, while for others it meant adding detail to their drawing or additional questions to their entry.

To encourage student's relationship with their journals, each week the instructors wrote a brief note in response to previous weeks' journal entry. The note often included encouraging

language about the work the student had completed, a question to further their thinking, and a sticker to show appreciation for their engagement. Students found the notes exciting and often read them allowed to each other when they received their journals each week. This helped them feel connected to their journals and excited to put more work into them.

During week two, students did a comparison of two organisms. The lesson was titled "Bugs, bugs, bugs" but students were encouraged to compare anything that moved to expand possibilities of finding critters and follow personal interests. Students included caterpillars, frogs, worms, slugs, beetles, ants, spiders, mosquitos, and more. Students built on what they learned and practiced during week one by using their skills of observation, journaling, labeling, and asking questions. Students did two species accounts before constructing a Venn diagram of comparison. Most students were familiar with how a Venn diagram worked and found it to be an accessible way to make comparisons across creatures.

As students shared and discussed their Venn diagrams, instructors introduced new vocabulary that students were already describing, including, competition, predation, mutualism, and commensalism. Most students had a foundation of knowledge to grasp ecological competition and predation, but mutualism and commensalism were new and difficult to incorporate into their own vocabulary. Their understanding of new vocabulary could have been improved by scaffolding their introduction more explicitly and circling back to the new vocabulary in subsequent lessons. It takes time and repeated introduction for new vocabulary to become familiar. Hopefully this lesson served as touch point that student can use to construct understanding in future lessons at school.

As a group, we discussed how the diagram was a representation of ecological niches, and the overlap of the circles represented some ways that ecological niches can overlap. Some

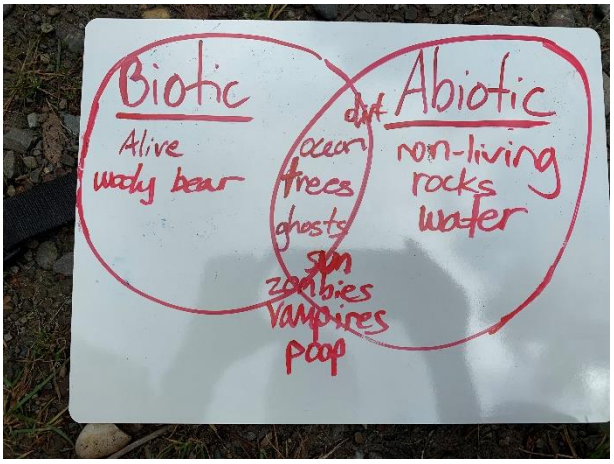
students had heard the word ecological niche before and were able to apply that knowledge in the discussion. To help students better understand the meaning of the word, instructors asked them to think and share about what their own ecological niche is. Students were able to articulate their habitat, diet, and other aspects of their ecological niche. When asked whether our niche had any overlap with any of the critters we had been studying and exploring, one student came up with the example that we use trees as a resource, just like a lot of other creatures in the forest such as birds, beavers, and bugs. Several students were able to point out areas where a human niche might overlap with other living things in the forest.

The third week of instruction zoomed way out from ecological niches and challenged students to landscape scale thinking. The creation of the relief maps was a way for students to make a model that represented an area bigger than they could see. The goal was to help them understand the concept of a watershed and explore how community pollutants might move through a landscape. Students were able to grasp the concept of the maps and enjoyed representing their communities visually. Most students included the forested park we were exploring on their map, as well as other ecosystem types such as steams, ponds, and urban environments.

Most students had heard of pollutants and could give an example from their community. Many identified a factory, farm, or street as a potential area with pollutants. One student identified the trash left in their school yard as a pollutant that could get into the watershed. Students showed understanding of how pollutants move through a watershed by identifying where pollutants were pre- and post-rain (spray bottle). They could track how and where the colors moved and mixed in their map and identify where the pollutants ended up in the landscape. The students expressed a lot of anticipation in discovering how the water would

interact with their maps and exclaimed loudly when identified pollutants mixed with the water features such as streams and ponds. The nature of spraying each map one by one provided students with ample opportunities to engage with each other's maps, make connections, and ask questions.

In culmination of the first three lessons, students created ecosystem maps during week 4 of Junior Naturalists. The ecosystem maps are an excellent tool to see the cumulative learning effects of this program and curriculum. The theme of the day was interconnections and leading up to the lesson, the group discussed and played games to understand difference of biotic and abiotic. For example, students played 20 questions and had to include the question, "Is it biotic or abiotic?" One student chose a stream as his word for students to guess and had difficulty deciding how to answer.



To help assess the students understanding of the words, each group created a Venn diagram on the white board together. Students called out things they were confident were biotic or abiotic and if someone disagreed, we put it in the center. The photo shows one example of these diagrams and the middle list includes dirt, ocean, trees, ghosts, sun, zombies, vampires, and poop. It was interesting that the center list ended up longer than either of the categories; the students seemed more interested in finding things that did not fit nicely in to one of the boxes. For example, one student claimed that the ocean was abiotic because it is made of water, but another student argued that because so many things were living in that water, the ocean was biotic. Students all agreed that trees were

biotic until one asked about stumps and logs. They agreed that stumps and logs were still trees but no longer alive, therefore trees could be biotic or abiotic. The list in the middle led to fruitful sense-making conversations about what the difference between biotic and abiotic, including the grey areas in between.

These conversations lead nicely into the ecosystem mapping activity because students incorporated both biotic and abiotic elements in their maps. This was a culminating project because it incorporated a lot of learning from the three previous weeks of the program. The first two weeks, student's journal activities were focused only on biotic components of the ecosystem and connections between them. The third week introduced thinking about abiotic components during the watershed maps. The ecosystem maps gave them an opportunity to put all those components together and start drawing connections.

There are 6 maps made by students to consider, labeled Student 1-6 (Appendix B). Student 1 made 6 connections between 7 observations. Their observations include a log, huckleberries, trees, birds, sky, leaves and moss. Their list includes both biotic and abiotic components but does not explicitly label any of them. The lines do not include arrows, indicating that the relationships are not one sided or directional. The student connects birds and the sky by noting that birds fly in the sky. The student connects trees and the log by noting that when trees die, they make logs.

Student 2 made 6 connections between 7 observations. This student includes forest, trees, branches, leaves, logs, mushrooms, and rocks. Their map is much more biotically focused and has three connections coming from the tree, noting that branches, leaves, and logs come from trees. The only possible connection they made between biotic and abiotic components are that the log fell on the rock.

Student 3 makes 6 connections between 9 observations. They include both biotic and abiotic components, including some cultural artifacts such as song lyrics, a violin, and a necklace. Their map also includes several questions, including "I saw a single bee, on a flower in the fall??!" Including questions was one option given in the instructions. Students were encouraged to label connecting lines with questions instead of a statement if they could not think of a connection. The sun is a central part of the map, its placement seeming to put it at a place of importance. This student included arrows in their map, all pointing away from the sun, indicating they did see the relationship as directional or one sided. The student put arrows both directions between the dried grass and old leaves but did not indicate why. They did leave a question asking, "I saw a ton of leaves changing color. Do plants change color in the fall too?"

Student 4 uses mostly visual representations on their map. The arrows are double sided, perhaps indicating they see a reciprocal relationship between the different elements. Their map includes leaves, trees, small plants, pine branch, mushrooms, water, beetles and grass. They have connecting lines between the observations. They made a connection between the leaf and tree, the water and the plants, and the water and mushrooms. Other than the water, their map is dominated by biotic components of the ecosystem.

Student 5 also used a lot of visual representation instead of words. Their map includes 6 connections between 7 observations. Their lines do not use arrows but there are clear connections between many of the observations. The sun is positioned at the top of the page and is connected to grass, trees, and mushrooms. There is also a connection between mushrooms and trees. The students represent complex connections between both biotic and abiotic components of the ecosystem.

Some trends across all the maps include making ecological connections using both visual

representations and words, considering relationships between biotic and abiotic components of the ecosystem, and including the sun. Only some of the students included humans or themselves in the maps but we discussed as a group after presenting the maps where and how we could add ourselves to the maps. Students were able to articulate many connections between themselves and the forest ecosystem, and some of those connections are reflected in the pre- and post-assessments.

Students answered three questions during the first and last weeks of the program: "who is a naturalist," "what is a naturalist", and "how are you connected to this place?" (Appendix C). By comparing student answers from week one to week four, changes in student understanding and thinking can be observed. Students answered the question "how are you connected to this place?" very differently from week one to week four. In the week one answers, there is a trend of answering with specific connections to ecosystem components, such as digging with a rock, slipping on a log, or eating a berry. During week four, students make broader connections and many of them mention their friends. One student answered week one that they were connected to this place because "I can use my digging rock to plant things" and during week four wrote, "with friends and nature that is essential to survival." This shows a shift in thinking from a physical, personal connection to a broader connection to people and place.

Students were also asked to answer the question "Who is a naturalist?" Many students did not answer this question week 1 and focused on "What is a naturalist?" instead. When they answered it week four, three students wrote "I am a naturalist," one student acknowledged their friends are naturalists, and one student wrote that many people are naturalists. This shift in thinking shows how students that were unsure who to identify as naturalists were able to self-identify and use the term naturalist as an identifier for others during the fourth week of the

program.

When students answered the question "What is a naturalist?" almost all of them mentioned nature in their initial definition and their week four definitions. During week one, most students said that a naturalist was someone who studies nature. During each weeks' lesson, instructors would explain how the activities connected to be being a naturalist. Instructors would point out how practicing observations, keeping a journal, teaching others, asking questions, and exploring the trails are all traits of a naturalists. Calling these traits out explicitly helped students construct their definition of a naturalist and helped them see themselves as naturalists.

After completing the four-week program, students used more diverse language to describe how naturalists interact with the forest. They use phrases like "explores nature," "observes nature," "feels connected with nature and wants to learn more about it," "takes care of nature," and "show people into the world of nature in a more learning way." This shows that students were able to expand and diversify their definition of what a naturalist is.

Conclusion

One of the goals of this project was to build a curriculum for the Junior Naturalists program at Wild Society that helps connect students and families to outdoor space in their communities. We accomplished this by inviting students to come learn in local parks and view the forest as a classroom that is always available to them. Many parents and guardians expressed not knowing that these forests and trails existed, and some even spent time exploring while the students were in class. Many students were excited to share what they had learned and explored with their families, sometimes dragging their siblings and guardians back out onto the trails after the program had ended. Families were able to connect to natural spaces in their communities and connect to each other through exploration and discovery. This is encouraging during a time when

so much learning and community building happens online. As we help people reconnect with the green spaces near them, I hope to build care, wonder, and hope for the ecosystems that are integral for our physical and mental wellbeing.

The diverse set of data captured by the ecosystem maps, indicates that students built on prior knowledge and made new connections from their experience in the program. Some students included questions on their maps, indicating that they felt confident that asking questions is the first step to learning something new. Students showed growth in making connections between biotic and abiotic components of the ecosystem, expanding their understanding of the interconnections between all living and nonliving things.

There are many ecosystem components that are underrepresented in the webs that the students drew. While I think that students showed impressive understanding of producers and consumers in their maps, I would like to incorporate more learning around decomposers and nutrient cycling when we run this program again. For example, instructors could incorporate discussion and learning about decomposers and nutrient cycling during the week one and two lessons by nature journaling about fungus and discussing how bugs function in nutrient cycling. If the program could be expanded to 5 or more weeks, a whole lesson on decomposers could be added.

This would have the potential to create more robust ecosystem connections on their maps and provide a broader picture of how the ecosystem functions. For example, some students drew connections between logs and fungus because they had seen them growing on the downed wood. Many of them recognized the physical connection but did not indicate understanding of the function that the fungus was playing in ecosystem by decomposing the log and recycling the nutrients.

In the pre and post assessment, students indicated that learning in the same park over the course of a month helped them feel connected to the ecosystem, land, and people. Returning to the same park with the same people four weeks in a row was a unique experience for many students and it cultivated a deep connection to the land and their group. Building personal connections with public land is something I hope to accomplish more of in the future. I am set up well to continue this work with Wild Society as we operate solely on public land.

Student answers to their post assessments indicated that many of them had a more robust understanding of what a naturalist is and some even self-identified as a naturalist. By recognizing that everyone is a naturalist, students can see each other, their families, and other community members as both learners and teachers. Many students made connections between naturalists and science, which can help them take ownership of their identity as a scientist. My hope is that they can take this identity with them back to classroom and walk into their science lessons confident as both a learner and a teacher.

The Junior Naturalists curriculum for this project was intended to connect students to local parks in their community, help them make ecosystem connections, and build community during a time dominated by the digital world. Students were able to engage with learning and each other during a tumultuous time dictated by the global pandemic. My hope is that families, educators, and students recognize the importance of outdoor education throughout life. People of all ages need to connect to the natural world. Raising awareness about the green spaces available in our communities helps create opportunities for connection and hope for continued support to maintain those spaces.

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Junior Naturalists Curriculum

This 4 week series is intended to build each week to help students develop their skills as a naturalist in their local parks. Students will be able to identify biotic and abiotic components of the ecosystem and how they interact. Students will begin to understand humans' role in the natural world.

Goals:

1. Connect to the natural world through a social, historical, and ecological contexts
2. Develop an identity as a naturalist
3. Build community through learning and teaching

Weekly Flow:

Each week has a series of topics to explore, walk and talk questions, games, activities, and a main lesson. Instructors are expected to teach the main lesson each week and use the supplemental activities of their choosing. Students will be provided journals by the program.

Main Lesson Flow:

Lessons are a four step process that guide the learner through discovery. This inquiry based pedagogy of teaching leaves room for the student's own wonderings to help guide the lesson. It is always a goal to walk away from the lesson with more questions than we started with.

1. **Explore:** Guide students through exploring a natural phenomenon outdoors.
2. **Investigate:** Students make observations and use prior knowledge to connect to what they already know.
3. **Research:** Guide students through deepening their understanding of the phenomenon they are learning about.
4. **Wonder:** Encourage students to ask questions about what they learned.

Week 1: Observing Our Ecosystem

Students will learn how to make informative observations about their surroundings. They will utilize the scientific process and nature journals to begin documenting their findings. Students will be encouraged to ask questions that they can investigate over the course of the program.

Topics to Explore: Land acknowledgement, humans *are* the natural world, stewardship, reciprocity, observation, Leave No Trace Principles

Walk and Talk Questions:

- Who has been on this land before us?
- Who is on this land now?
- Who is this land for?
- How can we be stewards of this place?
- What does the land provide us?
- What do we provide the land?

Games:

- Name Games
- WAP
- Big Blue Blow Pop

Activities:

- Team Agreement
- I Notice, I Wonder, It Reminds Me Of (BEETLES)
- Each One Teach One- Leave No Trace Principles

Week 1 Main Lesson: Nature Journaling

Summary: Students will learn observational skills and tools to explore their surroundings and make connections. Students will choose one natural object or organism to observe in detail.

Learning Goals:

- Students will learn tools and skills of observation
- Students will practice scientific inquiry
- Students will understand the power of questioning as way to learn about the natural world

Materials Needed:

- Journal
- Pencil+paper

Explore:

1. Give students ~10 minutes to explore an area
2. Encourage students to explore with all 5 senses (be sure to monitor tasting)
3. Ask students:
    a. What do you notice?
    b. What do you wonder?
    c. What does that remind you of?

Investigate:

1. Ask students to find one natural object or organism that they find interesting.
2. Ask the students to share their object with the group and share three things they wonder.
3. Encourage them to write down 2 of their questions in their journal.

Research:

1. Students will spend 15 minutes drawing their object.

    a. Remind students to look at the object from different angles, zoom in/zoom out, and use labels to capture components difficult to capture with drawing (ie. color, texture, ect.).

2. Ask students to write 5 things the notice or know about their object. Use the white to model.

    a. ie. the leaf is green, the leaf has 20 veins, this leaf is from a maple tree, the leaf is decomposing, the leaf is wet

3. Students can name their own object. If someone knows the scientific or indigenous name, they can include that as well.

4. Allow each student time to present their drawing and observations to the group. Explain how naturalists practice teaching each other to share knowledge and wonder.

Wonder:

1. Have the students revisit their wonderings from the beginning of the lesson.

    a. Did they answer any of their wonderings through observation?

    b. Ask the students to brainstorm how they could research the answers to their questions.

2. Ask the students to each write two more questions using the stem:

    a. I wonder _____?

Wrap Up:

Part of studying science and the natural world is leaving with more questions than we came with. Inquiry, wonder, and questioning are all ways for us to better understand the world. Observation and research can help us answer our questions and learn from each other.

Week 2: Flora and Fauna

Students will learn about local plants, animals, fungi, and insects in the park. They will be introduced to nature guides and tools for identification. Students will learn about the relationships between organisms and begin to understand their interactions.

Topics to Explore: Naming (indigenous, latin, common), what lives here, invasive vs native species, land management, food webs, competition, ecological niches

Walk and Talk Questions:

- What is a local plant you feel connected to and why?
- What is a local animal that you feel connected to and why?
- Can you think of one way a plant and animal are connected?
- If you could combine any two animals, which two would you pick and what would you call your new species?

Games:

- Predator vs. Prey
- Animal Charades

Activities:

- Each One Teach One- Flora and Fauna
- Perspective Stories
- Berry picking

Week 2 Main Lesson: Bugs, Bugs, Bugs

Summary: Students will have a chance to explore and catch critters they find. They will journal about their favorite specimens and make claims about how they survive in nature.

Learning Goals:

- Students will learn about insects they find by making observations and comparisons.
- Students will make visual models of ecological niches.

- Students will learn the words habitat, niche, competition, adaptation, and physical/behavioral trait

Materials Needed:

- Bug catching containers
- Notebook
- pencil/pen

Explore:

1. Give students 10-15 minutes to explore, looking for bugs
    a. Look underneath rocks and logs
2. Help students collect critters in containers where they can be safely observed
    a. Most insects are safe to pick up and hold, but when in doubt, leave it where you found it.

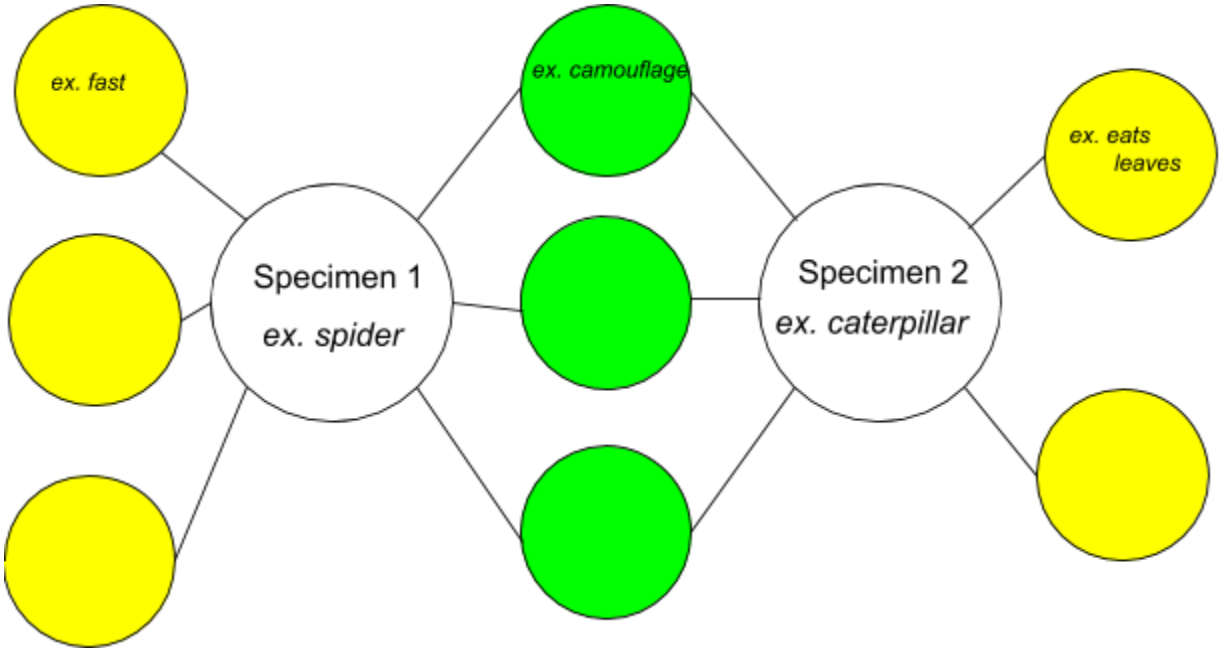
Investigate:

1. Spend some time with your students observing their captured critters and have each student select their 3 favorite specimens to investigate
2. In their journals, ask students to create an entry for each of chosen specimen:
    a. Name - it is ok to make up a name
    b. Sketch - don't worry about making it a masterpiece, but a quick sketch will encourage more detailed observation.
    c. Habitat: where does it live? - where did you find it? In the dirt? On a leaf?
    d. Food: what does it eat? - have students use observations and prior knowledge to make a claim about what it might eat.
        i. This can look like "I think it eats _____, because _____."
    e. Survival: how does it survive in nature? - students will make a list of physical and behavioral traits (or adaptations) they observe that might help their specimen survive (ie. speed, camouflage, hard shell, flying, etc.).

Name	Sketch	Habitat	Food	Survival
EX. spider	(picture)	*A web on an apple tree*	*I think it eats small bugs because I saw some caught in the web*	- *Speed* - *Fangs* - *Camouflage* - *Hairy*

Research:

1. Explain to your students that they just created a model of an ecological niche.
    a. "The ecological niche describes how a species interacts within an ecosystem. The niche of a species depends on both biotic (living) and abiotic (non-living) factors, which affect the ability of a species to survive and endure." - Ecological Niche: Definition, Types, Importance & Examples
2. On a new page, ask your students to create a compare and contrast mindmap for two of their specimens. Use the white to model.
    a. Drawing from the chart your students created during the investigation, have them fill in the mindmap - similarities go in the middle (shown in green) and differences go on the outside (shown in yellow)



3. Using the word bank below:

   a. Discuss and write down how your specimens might interact with each other and why?

   b. If you can't find ways they interact, why not?

Word Bank:

Competition - Ecological competition occurs when living organisms, including animals, plants, bacteria and fungi, need the same limited resources to thrive in their shared environment.

Predation - the pursuit, capture, and killing of animals for food. Predatory animals may be solitary hunters, like the leopard, or they may be group hunters, like wolves.

Mutualism - an association between organisms of two different species in which each benefits. Mutualistic arrangements are most likely to develop between organisms with widely different living requirements.

ex. a honeybee needs nectar to make honey and the flowers need the bees to pollinate them and help them reproduce

Commensalism - in biology, a relationship between individuals of two species in which one species obtains food or other benefits from the other without either harming or benefiting the latter.

ex. barnacles use whales as a place to live and a way to move around, but the whales aren't harmed by them.

Wonder:

1. Ask your students, what do you think would happen if two species tried to fill the same niche?
    a. You can guide them back to the definition of competition in the word bank and think about how species that needed all of the same resources would have to compete for them.
2. Discuss with your students:
    a. What is your niche?
    b. What traits/adaptations do humans have that help us survive in our niche?
    c. If you could have one bug trait you observed, which would you pick and why?

Wrap Up:

Traits are not random. When we look at species closely we can learn how they fit into the ecosystem around them and how they interact with other living organisms. Organisms adapt through evolution to be the best competitors in their environment.

Week 3: Cycles, Cycles, Cycles

Students will explore the many cycles that are integral to the function of an ecosystem. They will explore components of the water cycle, nutrient cycles, and life cycles.

Possible Topics: water, fire, decomposition, nutrient cycling, seasons, phenology, erosion.

Walk and Talk Questions:

- How does fire interact with the land?
- Where do dead leaves go when they fall to the ground?
- Where do the raindrops go?
- In what ways has the forest changed since week one?
- In what ways is the forest the same?

Games:

- Yes Game
- Bird Foraging Relay

Activities:

- FBI investigation
- Story Telling: the Story of a Drop of Water
- Sound Maps

Week 3 Main Lesson: Water Works

Summary:

Students explore watershed science through a hands-on activity involving design, building, and critical thinking. Students will explore how water moves through a landscape and how this can have both positive and negative effects.

Learning Goals:

- Students will be able to describe what a watershed is
- Students will articulate how their actions can affect the watershed they live in

- Students will learn what a topographic map is by observing the flow of water through a model watershed
- Students will learn about pollutants and how they might move in water runoff

Materials Needed:

- Multiple sheets of paper (thicker paper works better)
- Markers or ink pens (something that will run when it gets wet!)
- Water
- Optional: spray bottle, hose sprayer, or watering can

Explore:

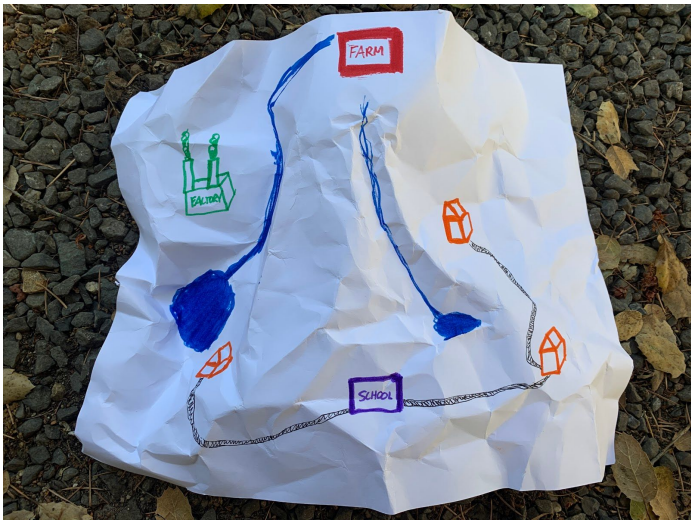
1. Give students 10-15 minutes to explore the outdoor space
2. As a group, explore pouring water on various surfaces.
    a. Slopes, flat ground, plants, rocks, trail, etc.
3. Ask your students to make observations of their surroundings:
    a. What do you notice about the way the water moves?
    b. Do you notice any places where streams form, which direction does the water travel?
4. Discuss with your students:
    a. Where do you think the water goes when it rains?
    b. What ways do humans change the way water moves across a landscape?

Investigate:

1. Give students a piece of paper and ask them to crumple it into a ball
2. Stretch the paper back out on a flat surface, but do not smooth or flatten it all the way


3. This bumpy paper is now a landscape like a topographic map. Ask the students to draw the following components onto the “map” using multiple colors. They can use symbols or more detailed drawings:

    a. 3 houses
    b. Farm
    c. School
    d. Streets
    e. Lake
    f. Stream
    g. Factory
    h. Park
    i. Any components that are important in their own community/neighborhood!



4. Explain that a topographic map is a bumpy map that shows the mountains and valleys of a landscape.
5. Identify which components of the map might have pollutants and what they might be.

    ie, the farm has animal manure, a house has fertilizer on the lawn, the street has oil from cars, etc.

6. Ask your students and have them discuss verbally or write down their answers:

    a. What do you think will happen when we simulate rain and spray water on the models?

   b. Where will the water pool/collect?

   c. Which direction(s) will the water flow?

7. Spray water on the paper topographic map.

8. Observe with your students where the water goes and how the colors move around:

   a. What was surprising about the way the water moved?

   b. Did the pollutants you identified mix into the water?

   c. Where did the pollutants end up? Did they flow into any of the "streams" or "lakes" or "parks?"

      Ie. the red ink from the farm flowed into the river and lake

   d. Did any of the buildings flood?

Research:

1. Have your students recreate the topographic map using dirt and natural objects.

   a. Encourage them to accurately represent the hills and valleys created on the paper by mounding the soil.

   b. Place objects (sticks, leaves, rocks, etc.) to represent the components of the community (buildings, parks, etc.).

   c. Ask students to make adjustments based on how the water in their paper model flowed to prevent pollutants from flowing into water sources.

2. Identify where on the topographic map the potential pollutants are.

3. Spray water on the dirt model

   a. How did the water move differently in the paper model and the dirt model?

   b. Where did the water pool?

    c. How does the water interact with the soil?

4. The paper and the dirt maps are models of watersheds.
    a. Watershed: an area land that separates waters flowing to different rivers, basins, or seas

Wonder:

1. Discuss with your students these questions:
    a. Why is clean water important?
    b. How could we prevent pollutants from flowing into our water?
    c. How can we protect our parks from pollution and erosion?

Wrap Up:

Water connects the landscape, living things, and nonliving things. It is a source of life, carrier of nutrients and pollutants, and erodes earth around us. Water is so important in every landscape and connects many of the cycles that the ecosystem depends on.

Week 4: Interconnections

Students will look at the forest as a whole and make connections between themselves and the natural environment. Students will reflect on their growth as a naturalist and own their identity as scientists.

Walk and Talk Questions:

- Tiny Teach: What is the coolest thing you learned during this program? Teach your partner.
- How many different ways are you affected by biotic and abiotic factors that you can see right now?
- What are you going to do after this program to keep learning about the outdoors?

Games:

- The Beast
- Vroom

Activities:

- Space Walk- How have you grown as a naturalist?
- Solo Sit/Journal Reflection

Week 4 Main Lesson: Ecosystem Maps

Summary: Explore what makes up an ecosystem and ponder how humans connect to the systems around us.

Learning Goals:

- Students will be able to explain what an ecosystem is
- Students will explore what lives around them and how living things connect to non-living things
- Students will wonder about their place in the ecosystem and how they are connected to living and non-living things

Materials Needed:

- Journal

- Pencil
- Large paper
- Markers/crayons

Explore:

1. Give students 10-15 minutes to explore a designated space
2. Encourage students to explore with multiple senses
    a. What do they see?
    b. What do they smell?
    c. What do they feel?
    d. What do they hear?

Investigate (15-30 min):

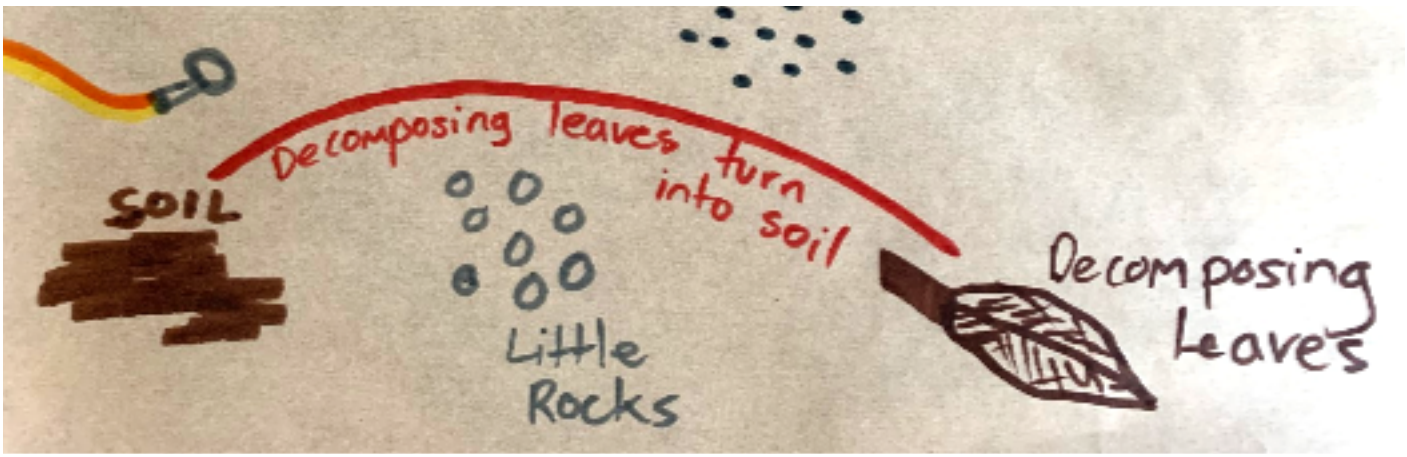
1. Give student(s) 10-15 minutes to write a list of everything they see around them.
2. Here are some prompting questions to ask your students and fuel their exploration:
    e. Can you find something for each color of the rainbow? (red, orange, yellow, green, blue, purple)
    f. How many living things can you find?
    g. How many non-living things can you find?
    h. What is the weather like today?
3. Find a flat place to lay out the large pieces of paper. Using markers or pencil, students will draw or write each observation from the list

Research:

1. Using a bold color, ask the students to draw connecting lines between the observations on the poster and write why they drew those connections (connections could be physical, observed, food chain, cycles, etc)

ie. plants and the soil are connected physically underground through the roots

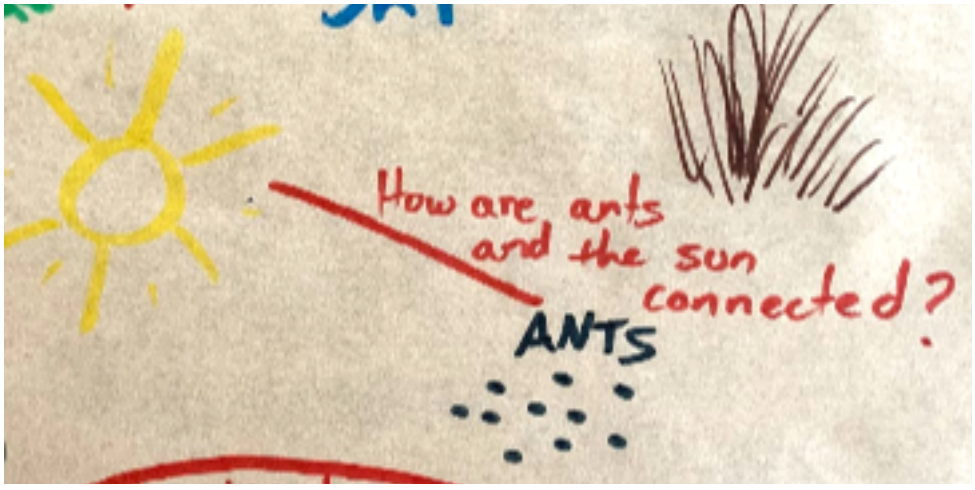
ie. the caterpillar and the leaf are connected through the food chain because the caterpillar eats the leaf



2. For connections they are unsure about, add a line and a question about the relationship between those two observations of the ecosystem

   ie. How are soil and wind connected?

   Ie. How are beetles and squirrels connected?



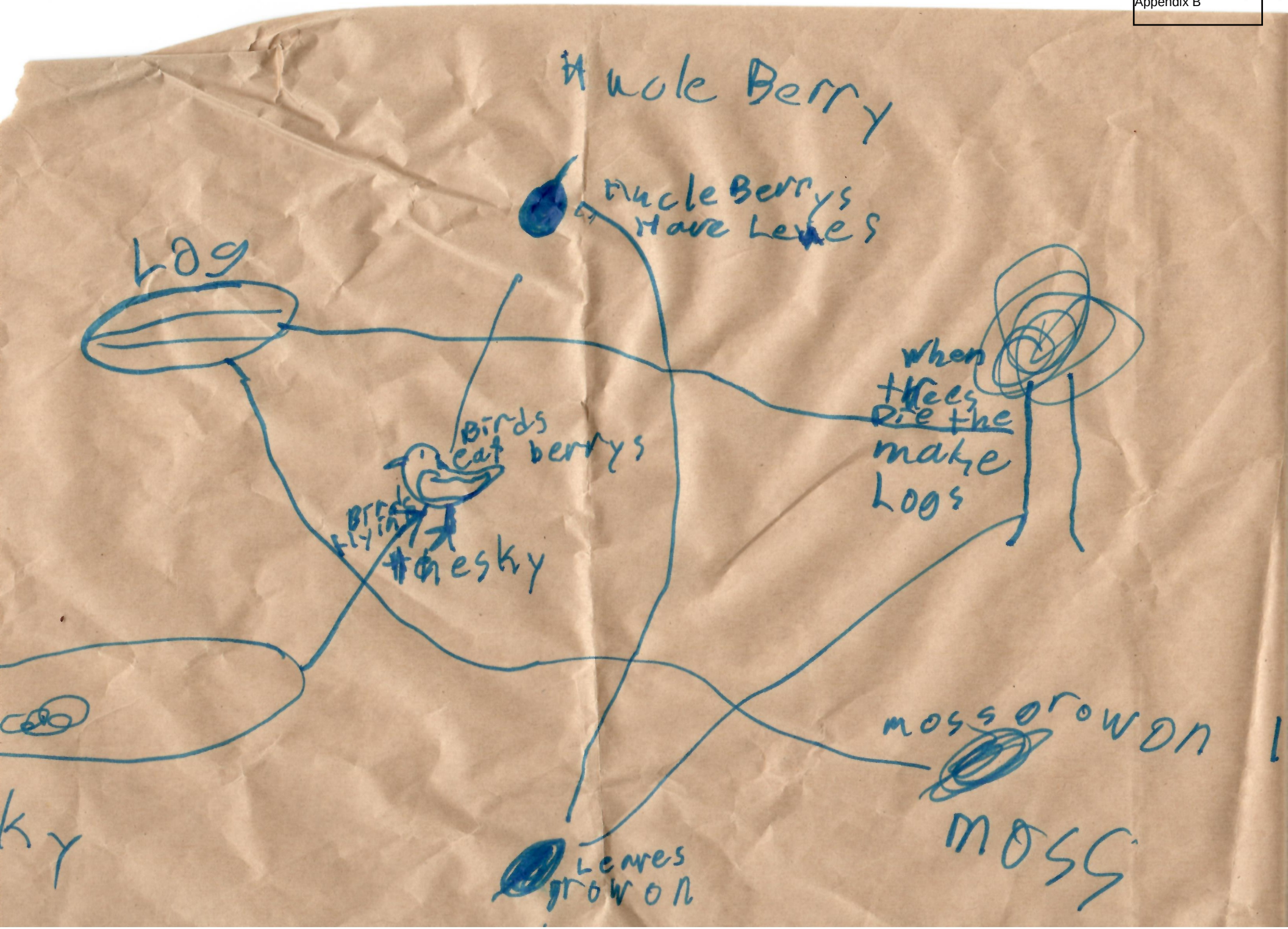
3. Have each student share their ecosystem map with the group. Encourage them to share one question with the group and open it up for discussion.

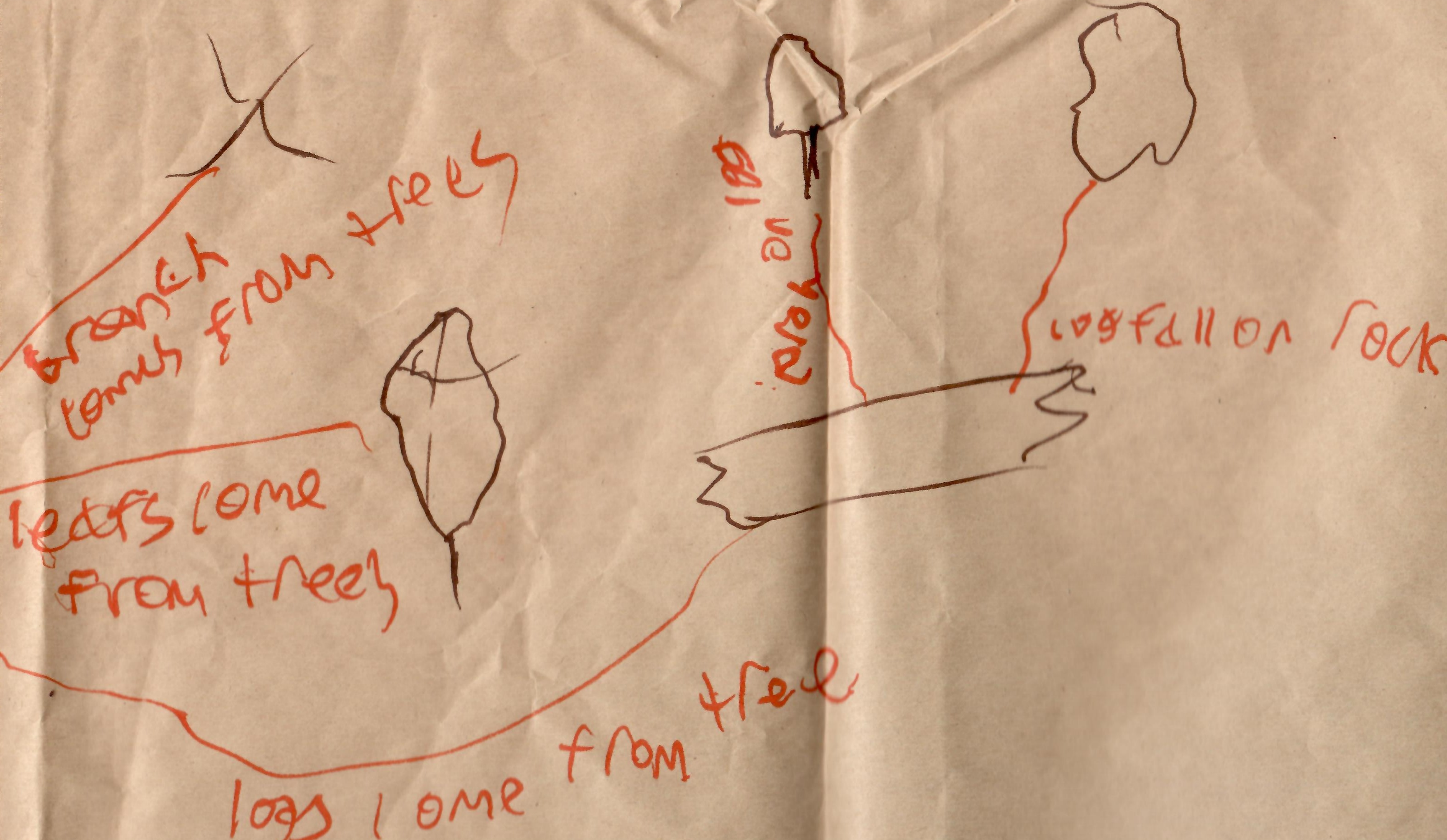
Wonder:

1. Ask your students, what is an ecosystem?
    - The poster is one representation of an ecosystem, help them use it to come up with a definition
    - *Ecosystem Definition: a community of organisms living and interacting with their environment*
2. Discussion Questions:
    - What is different about other ecosystems you have been to (help them come up with an example of somewhere else they have visited)?
    - What connections do you want to investigate further?
    - How are humans connected to the ecosystem you drew? Can you add yourself to the map?
    - What questions do you have about the connections on your poster?

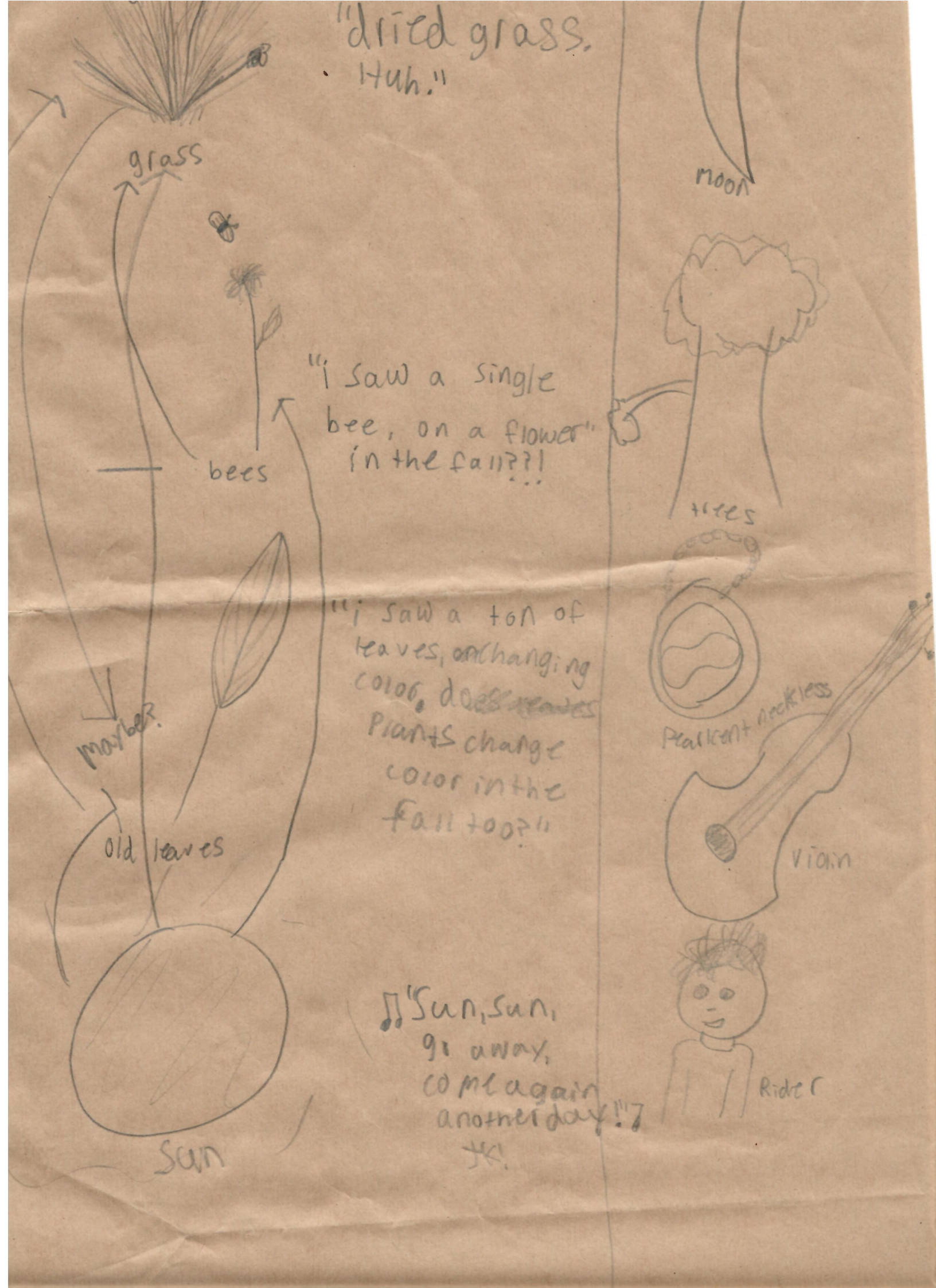
Wrap Up:

Ecosystems are a web of interconnections between living and nonliving things. Humans are a part of that web and affect the other pieces of the system. By making connections between the things we observe, we can begin to understand how everything is connected, even us!


Uncle Berry
Uncle Berrys Have Leaves
Log
When trees Die the make Logs
Birds eat berrys
Birds flying
the esky
mossgrowon
MOSS
Leaves growon



branch comes from trees
leafs come from trees
log fall on rock
logs come from tree

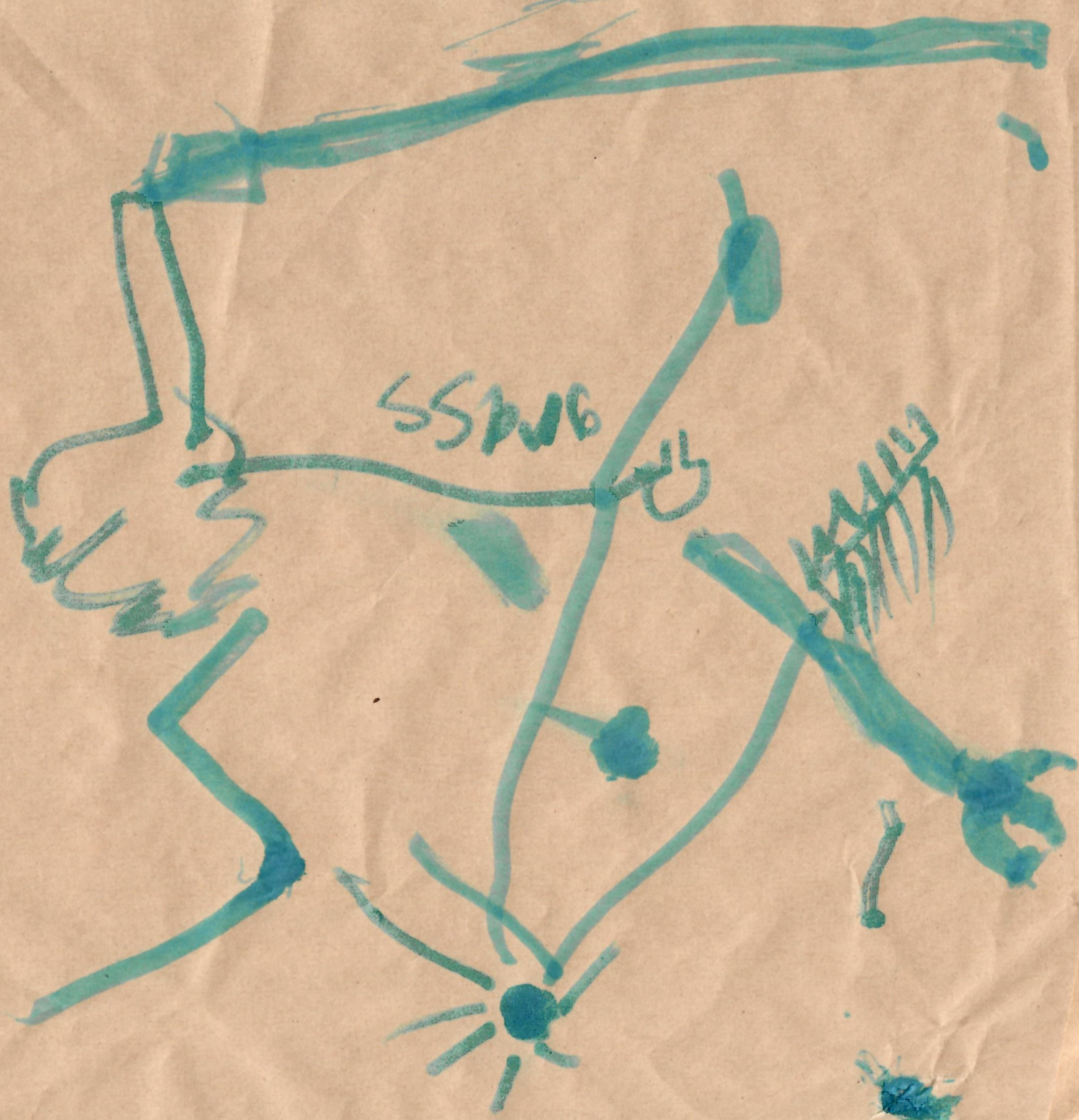

"dried grass. Huh."
grass
moon
"i saw a single bee, on a flower" in the fall?!
bees
trees
"i saw a ton of leaves, changing color, does ~~leaves~~ Plants change color in the fall too?!"
marker
Pearl necklace
old leaves
Vian
♫"Sun, sun, go away, come again another day!"♫
Rider
Sun

Sipley
Simply

Pine

I saw some beetles

Mushrooms



Appendix C

Data Table_Junior Naturalists_Pre/Post Assessments

Connections= How are you connected to this place?
Who= Who is a naturalist?
What= What is a naturalist?

1= Week one data collection
2- Week 4 data collection

Student	Connections_1	Who_1	What_1	Connections_2	Who_2	What_2
1	I can use my digging rock to plant things.		They help and study nature.	With friends and nature that is essential to survival	I am a naturalist and my friends are naturalists	A naturalist is someone who explores nature
2	There are berrys here. I like berrys. :3	I think Sarah is a naturalist.	(I forgot what that is.)	Because I got to know it better.		A naturalist is a proson who studys natur.
3	We are connected by pie. We are connected because we can change the eco sistom.		A naturalist is a person who stutys nature.	We are all connected to nature through necesities that nature can provide.	I am a naturalist. Many people are naturalists.	A naturalist is someone who observes nature.
4	Bees. Nature. Sliping on logs. Slug.		A person who works with nature.	I am connected by my friends and animals and plants.		A naturalist is a person who feels connected with nature and wants to learn more about it. They study nature and things that live in it.
5	Because I love the out doors.		a naturalist is someone who study nature.	Because I love this place.	Steve Irwin.	A person who takes care of nature.

Data Table_Junior Naturalists_Pre/Post Assessments

Connections= How are you connected to this place?
Who= Who is a naturalist?
What= What is a naturalist?

1= Week one data collection
2- Week 4 data collection

6	Simply by being here myself.		Someone who observes nature and studys it.	Visiting. Knowing that everything I do somehow impacts the beautiful nature that is all around us.		Someone who knows lots of things about nature like the world under the sea or the woods. And who use's that skill to do tours. Or show people into the world of nature in more of a learning way.
7	With nature because I have grown up with Nature.		Someone who teaches about nature and I learns.			
9	Bees and slugs.	I am a naturalist.				
10				I am connected by all living things. I am a part of the life cycle. We all are.	I am a Jr Naturalist :D :D lly nature.	A naturalist is a person who studies nature.
11	I like berrys. I am Julia Berry.		Someone who study nature.			