Environmental Leadership Program

CANOPY CONNECTIONS 2016

Nurturing Connections in HJ Andrews Experimental Forest

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Curriculum Overview

Canopy Connections is a community service organization composed of undergraduate and graduate students from the Environmental Leadership Program housed within the University of Oregon's Environmental Studies department.

We are working with HJ Andrews Experimental Forest and the Pacific Tree Climbing Institute in order to mentor 200 middle school students from schools in surrounding areas.

Our mission is to create a generation of individuals inspired to connect and interact with nature, and we aspire to motivate lifelong community participation and environmental stewardship.

The conceptual framework we have based our curriculum on stems from the Awareness to Action approach presented in the 1977 Tbilisi Declaration. This emphasizes developing awareness, knowledge, skills, and attitudes to motivate environmental action. We have also incorporated aspects of Coyote Mentoring which focuses on guiding learners through an educational experience that includes exploration of curiosity, creativity, and personal growth through meaningful connections with nature. Furthermore, we measured our curriculum according to the North American Association for Environmental Education Guidelines for Excellence.

Our lessons ultimately aim to provide outdoor skills, environmental knowledge, a lasting connection to nature, and an inspiration to develop a continuous relationship with the outdoors after the trip. Through our lesson activities we will be emphasizing observation skills as a tool applicable to all aspects of scientific and artistic exploration. Additionally, we will be implementing educational connections to HJ Andrews' programs of Long Term Ecological Research and Reflection. Our lessons will include multidisciplinary activities of art, science, and literature. We will utilize sit spotting, journaling, mapping, scientific method based activities and storytelling to accomplish our primary goal as environmental educators, to foster deep connections between students and their environment. To do so, we created four separate stations including one focused on the humanities and journaling, a station discussing decomposition, an identification station utilizing dichotomous keys and a tree climbing station showing differences in forest layers.

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Pre-Trip Lesson
Terms of the Forest

Developed by: Alli Humphrey and Sky Worman

Adapted from:
2015 Canopy Connections Curriculum

Time: 50 minutes

Overview
The pre-trip lesson is designed to familiarize and connect students with the terminology and processes of an old growth forest. In the warm-up activity, students and educators will be able to assess and evaluate the student's current knowledge on biodiversity and forest ecology. Students will learn the importance of their own cultural connections to nature systems, and to explore the value of biological and cultural diversity. Throughout these activities, students will gain a familiarity with the species they may encounter at H.J. Andrews Experimental Forest.

Rationale
There are many conceptual links between human and environmental diversity including: age, socioeconomic status or different kind of species, ecosystems and habitats. Diversity does not only encompass humans but a multitude of different animals, plants and microorganisms, some of which can be found in the habitat of the H.J. Andrews Experimental Forest. It is important to understand the diversity of the environment in relation to the diversity of human life processes, and how we relate to one another and the environment. In a constantly widening world, children need to be prepared to interact with and learn from those who do not share their cultural norms and backgrounds. Differences in communication can lead to assumptions and pre-judgements, which are the root causes of interpersonal, local and global conflicts. This lesson is intended to allow students to acknowledge and compare the diversity within the class to instill the conceptual framework of understanding the importance of diversity in every environment. This framework is intended to prepare students for the fieldtrip to H.J. Andrews by familiarizing them with terminology to the biodiversity found in the old-growth forests of the Pacific Northwest. Biodiversity is important for many of the same reasons that cultural diversity is important: it creates richness and interdependence between species in the same ecological community. Many of these species have mutually beneficial relationships and depend on each other for survival. If students are able to see real benefits of diversity in the forest, they can better apply these lessons to the cultural diversity around them.

Learning Outcomes

By the end of the pre-trip lesson, students will be able to:

1. Identify useful vocabulary terms that will be used on during the trip.
2. Demonstrate knowledge of the contribution of diversity within society.

Link to Standards

Next Generation Science Standards

MS-LS2-2: Ecosystems, Interactions, Energy and Dynamics: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

The pre-trip lesson gives students experience in discussing patterns between organisms in the old-growth forest of the Pacific Northwest. By discussing the predictable patterns and interactions between Salal, Douglas-Fir, Western Hemlock, and Pacific Yew, students gain skills to discuss patterns across the ecosystems.

Materials Needed

- ➢ Term slips (Terms and Definitions on separate slips found in Appendix A)
- ➢ Background information on Jerry Franklin, H.J. Andrews, and LTER
- ➢ Prepared questions for pop-up game located in step two of lesson.

Activity Description

Step 1: *Icebreaker: Nature Get-to-Know-You Game* *Time: 7 min*

- ➢ Introduce yourself:
  - Explain why you are in their classroom
  - Say an interesting thing about you
- ➢ Explain to students that you would also like you get to know the students of the classroom
- ➢ Prompt the class with the following questions
  - What is your name?
  - What is an interesting fact that someone might not know about you?

Step 2: *Pop up Game* *Time: 13 min*

- ➢ Direct students to crouch down near their seat.
- ➢ Share directions:
  - I am going to read a series of statements. After I read each one, please silently pop up if the statement is true for you. Then return to the crouching position after a moment.
  - We will respect the answers of every student. Whatever is shared in this space doesn't leave the room.

- I will be asking questions that relate to diversity (ask: does anyone know what diversity is) and to your personal experiences with nature, so as we pop up, consider how the concept of diversity relates to the environment.
- There is no pressure to pop up if you don't feel comfortable doing so.
- We will be participating with you and sharing this experience.

➢ Read the following statements clearly and after each question ask students to notice where they are in relation to others (up or down):
Note: It is beneficial to engage students with further questions about what they have shared about themselves to make things more personal and engaging.

- Pop up if you've ever climbed a tree.
- Pop up if you've ever been camping.
- Pop up if you have ever felt a connection with nature.
- Pop up if you have heard of the scientific method.
- Pop up if you've ever explored nature by yourself.
- Pop up if you've ever written a poem before.
- Pop up if you can name at least one tree species native to Oregon.
- Pop up if you've ever felt inspired while in nature.
- Pop up if you speak another language.
- Pop up if you have ever been made fun of for your ideas, thoughts or opinions.
- Pop up if you feel like the environment should be protected.
- Pop up if you have ever stood up for what you believe in.

➢ Debrief Activity with discussion: Invite students to discuss and debrief the activity, using the following questions. Ideally, students will volunteer answers. If answers are not forthcoming, call on students to share.

➢ Examples of questions to ask during debrief:

- Q: Raise your hand if you learned something new about any of your classmates today.
- Q: How did you feel while participating in the activity?
- Q: How did you feel when there were only a few of you that popped up?
- Q: Why do you think we did this activity?
  - A: To recognize the ways in which each student may be different from one another. In this classroom there are many different people with many different experiences, interests, likes/dislikes and so on, and these characteristics are what make us diverse from one another. This is diversity.
- Q: What's the benefit of having diversity in our social community?
  - A: To allow ourselves to experience and learn about new things
- Q: How does environmental diversity relate to social, or cultural diversity?

        - A: We value both environmental diversity and cultural diversity, they both allow us to learn new things and explore the many differences that make things unique.
- ➢ Explain: Another word for biological diversity is biodiversity.
    - Q: Can anyone tell me what biodiversity is?
        - A: the variety of life in the world or in a particular habitat or ecosystem
- ➢ Explain: Just like there is a lot of diversity in this classroom and our community, there is also a lot of diversity in the forest. In our communities we are all unique in our own ways, but we all work together with our families and friends to create a working community, similar to our community, the many unique organisms of a forest also work together to maintain a healthy forest community full of biodiversity.
    - Q: Can anyone think of an example of a habitat with a lot of biodiversity?
    - A: old-growth Pacific Northwest forests such as H.J.A.
    - Q: What's the benefit of having diversity in a natural ecosystem?
    - A: To maintain a healthy habitat where many plants and animals can thrive together.

Step 3: *Mingle Matching* *Time: 20 min*

Introduction Time: 3 min

In this activity, the students will become familiar with some of the important terminology that the instructors will be using during the field trips at the H.J. Andrews Experimental Forest. Each term has a definition to be matched with. Students will be split into two groups, one side will be provided with the terms, and one side will be given the definitions. Students will engage in conversation to try and find their match, then after they have found their match, students will need to sit down in order to show that they are done. After the game students will take turns reading their matches aloud to the class.

Note: Clearly provide instructions to the game while students are still sitting in their seats.

- ➢ Provide instructions
- ➢ Divide students into two halves, Have students count off by saying "one" or "two" and instruct all one's to move to one side and all two's to move to the other. They will them mingle with each other for 10-15 minutes, and attempt to match each term with its description.
- ➢ Facilitator passes out definition and term slips. Be sure to pass out complete pairs (every term has a definition and visa-versa). If there are an odd number of students, a facilitator can join in on the activity. Make sure to spark a brief discussion on a couple of terms to get the students engaged with the activity.

Mingle Time: 10 min

- ➢ Give the signal for the students to mill about the room, trying to find the match to their term/definition. Roam around, answer questions, guide students in the right direction

through inquiry, and help them use the terms/definitions and their worksheet to figure out the correct match.

Review Time: 7 min

- ➢ Once all the students find the partner for their term/definition, and the pairs are sitting down together, use your key and instruct the students to read out the matches they found. Then ask the class using thumbs up/down/sideways if they agree, disagree, or are unsure whether the term and the definition match correctly. Verify whether or not the definition and term were matched correctly.
- ➢ It is optional to provide a worksheet to the students to fill out as they go over the correct definitions.
- ➢ After going over all of the terms and definitions, inform the students that these terms will be used on their field trip as they learn about these magical forest ecosystems. Terms and definitions can be found in **Appendix A.**

Step 4: *Conclusion: How to Prepare for the Fieldtrip* *Time: 10 min*

- ➢ Wrap up the lesson by returning to the theme of research: share with students that they are getting to visit a famous research station and explore an amazing old growth forest.
- ➢ Introduce theme of Students As Scientists (1.5 minutes)
- ➢ Using inquiry, ask:
    - Q: What is a scientist?
    - A: A scientist is someone who is studying or has expert knowledge in the natural or physical sciences.
    - Q: What is the scientific method?
    - A: The scientific method is a method of research where a problem is identified and research is conducted, data is found to create a hypothesis and then test it.
- ➢ Introduce HJA Experimental Forest
    - Q: What is an experimental forest?
    - A: A forest that is home to many scientific and ecological experiments and research projects.
        - Explain: Scientists us the scientific method to conduct experiments and collect data at H.J.A.
    - Q: How long do you think an experiment might take at H.J Andrews Experimental Forest?
    - A: It can last longer than a lifetime.
        - Explain: Some experiments need to be taken over longer periods of time in order to get useful data. For example, Jerry Franklin is a scientist that is working on a 200 year log decomposition study at HJ Andrews. This is meant to study the decay of a tree in terms of its own lifespan rather than the lifetime of a human. It takes more time for a log to decompose then it does for a human to live their entire life, this means that the experiment

needs to be longer than a lifetime in order to be able to understand the process fully.

- ➢ Explain: In addition to time scale scientific experiments, H.J. Andrews also incorporates Long Term Ecological Reflections that focuses on a multidisciplinary, humanities approach.
    - Q: Does anyone know what humanities consists of?
    - A: Social Science, Art, Literature and Music
    - Q: Raise your hand if you are more interested in science and math.
    - Q: Raise your hand if you are more interested in art, music or literature.
        - Explain: Aside from scientific researchers, the experimental forest invites poets, artists, photographers, musicians and many others to incorporate the old growth forest in their field of expertise. The forest is place for both scientists and artists!
    - Q: Why might it be important to invite artists, poets, musicians, etc. to do reflections at H.J. Andrews?
    - A: Aside from scientific observations that explain the relationships between the many diverse organisms in nature and how they interact, it is also important to explain the relationships between humans and nature.
        - Explain: The LTER is designed to allow people to explore humans' relationships and connections with nature through poetry, journaling, art and music. Researchers identify the way nature makes them feel, and why it is important to connect to nature.
    - Q: Why might it be important to spend time in nature?
    - A: To have fun, to see beautiful things, to find peace of mind etc.
        - Explain: When we go to HJA you all will have the opportunity to explore the feelings and thoughts that you have while spending time in nature.
- ➢ Debrief: HJA is a place for scientists and artists, so whether you enjoy one or the other more, there will be fun activities that everyone will be able to enjoy.
- ➢ Describe the stations and general flow of the day: explain to the students the agenda. (Field trips will be at 9am, where we will take 30 mins for orientation and splitting into groups. There will be four themed stations that will each be approx. 75 minutes, with a 30 minute lunch. Each group will start at a different station and cycle through them all, so the order does not matter. After all four groups have completed each station we are all going to meet back together wrap up the day).
- ➢ Segue by telling the students just as scientists always prepare for a day out in the field, so should they.
- ➢ Ask student to help list item they should remember to bring. Write list on board.
    - Dress in layers
    - Bring lunch
    - Raincoat, boots and pants (if they have them)

- Water bottle
- No electronics or jewelry
- Hair ties for students with long hair
- Open mind
- Thirst for adventure
- Willingness to try something new

Introduction
Welcome to H.J. Andrews

Arrival at H.J. Andrews, Orientation, Safety Talk and Break into Groups.

Time: 30 minutes

Activity Description

Step 1: *Welcome* *Time: 3 min*

- As school-bus pulls up to the pavilion, one educator boards bus and energizes students while giving instructions. Introduce yourself, welcome students to H.J. Andrews and give instructions: if you have to go to the bathroom, follow Educator A [point out leader who is outside of the bus]. If you are a chaperone, follow Educator B [point out another leader]. If you are ready to get started, follow Educator C [point out final leader].
- While this activity is happening, the other three educators spread out outside of bus for group dispersal

Step 2: *Group Introduction* *Time: 10 min*

- Group gets off the bus.
- Educator B briefs chaperones on expectations:
    - Allow students to answer questions, and think critically, explain that you may pause after questions.
    - No "selfies", explain the photo symbol (dot by name) for no-photo children
    - Stay on trail, at back of group.
    - Accompany students to bathroom if needed.
    - Participate in or do not disturb group activities.
    - Ask about their background, thank them for coming.
- Educator A leads trip to the bathroom and Educator C's group gets into a circle on the grass. While students are congregating in the circle, Educator C engages students by asking what they hope to see today as well as questions they may want to solve on the field trip at H.J. Andrews.
- Playing a warm up game is an option to get students warmed up and excited about their day.

Step 3: *Splitting up into groups* *Time: 5 min*

- Different colored hard hats will be placed on different tables for each group, each hat will also have the name of each student.
- Instruct students to find the hat with their name on it.

- ➢ Educators one by one hold up their helmet and announce, “If you are holding a [color] helmet, join me!”
- ➢ Once students have joined their group, facilitator begins.
- ➢ Each facilitator leads the group into giving gratitude. Educator begins by introducing themselves and expressing how thankful they feel to be at H.J. Andrews today.
- ➢ Ask students to go around the circle, introducing themselves and sharing one thing that they are grateful for in nature or one thing they noticed on the drive up to HJ Andrews.

Step 4: *Agenda and Logistics* *Time: 5 min*

- ➢ Introduce the concept of the field journal to students, inform students that they will be utilizing the journal throughout the day to make observations, create art, journaling and any other information they may collect along the way. Inform students that they will be rewarded with a prize at the end of the day for a completed journal.
- ➢ This is also a good time to address the worksheet that will be given to students at the end of the day.
- ➢ Go over Agenda:
  9:00-9:30 welcome/orientation
  9:30-10:45 first station
  10:45-12:00 second station
  12:00-12:30 lunch
  12:30-1:45 third station
  1:45-3:00 fourth station
  3:00-3:15 closing ceremony

  The Field Journal
  These journals are a tool for educators’ assessment and learners’ self-assessment that allow them to track their learning throughout the day. The questions in the field journal correspond with learning outcomes from each station. To explain the field journal to learners, tell them that they will have the opportunity to learn material that will help them answer these questions throughout the day and that completion of the field journal will earn them a Canopy Connections sticker.

  Note: The sticker will be printed at by the team and designed by the Canopy Team. For design, see Appendix B.

Step 5: *Setting Ground Rules* *Time: 5 min*

In smaller groups, facilitator will expand further on rules presented in the introduction. Ask if there are any rules for how we should act in the forest and on the field trip. If students miss any of the rules listed below, please add to their list.

Ground Rules

- ➢ Stay on trail
- ➢ Stay together
- ➢ Follow directions from whoever is leading the activity
- ➢ Be respectful
- ➢ Be responsible
- ➢ Ask a question if you have one

Step 6: *Depart to Trail*

Station One
The Tree Climb: Ascending the Giant

Developed By: Canopy Connections 2015

Time: 75 Minutes

Overview
This activity takes students ninety feet up into a Douglas-fir tree to experience an old-growth forest from the canopy level; allowing them to experience a part of the forest that is often left to the birds. This activity is led by the Pacific Tree Climbing Institute, and they will be providing gear and the pre-activity safety orientation. Students will use observational and critical thinking skills to hypothesize how conditions will change as they ascend the tree. As humans are usually restricted to the forest floor, climbing up into the canopy offers a special opportunity to experience another layer of the ecosystem that is H.J. Andrews. At the end of the climb, ELP leaders will take part in a group discussion on the observations made by students at various levels on the tree-climb.

Learning Outcomes
By the end of this lesson, students will be able to:
1. Describe the differences at various levels of an old growth forest.
2. Describe the experience of climbing the tree

Rationale
Climbing a Douglas-fir will open students' awareness to a different perspective of the forest ecosystem and canopy ecology. Because the students will already be excited and amazed by this activity, we hope to instill a sense of inspiration and cultivate a deep appreciation for the forest. In this activity students will learn how to overcome physical and mental challenges, allowing them to experience the sense of accomplishment and personal growth that comes with pushing oneself beyond one's usual limits.

Materials Needed
- ➢ Extra hair-ties
- ➢ Existing thermometers mounted on tree

Background Information
Old growth forests are comprised of multiple vertical layers, each with a unique set of characteristics that create different types of habitats suitable for the diverse communities of organisms living there. The three layers of the forest that student will encounter during their climb include the forest floor, the understory, and the canopy.

Forest floor**:** Consists of mainly woody debris, small ferns, and shrubs such as Sword Fern, Oregon grape, and Salal.

Understory: Consists of seedlings and saplings of canopy trees along with understory shrubs and herbs. Leaf size of the trees in the understory tend to be large so they can maximize the amount of sunlight they can take in and use as energy to grow. Species include sword ferns, young Western hemlock, Douglas-firs, etc.

Canopy: Consists of adult trees such as Douglas-fir, Western Hemlock, and Western Red Cedar. Leaf size up in the canopy tends to be smaller because they are able to receive more direct sunlight and don't need to waste energy on making larger leaves.

http://cfs.nrcan.gc.ca/projects/63

Activity Description

Step 1: *Introduction* *Time: 5 min*

- ➢ Gather students around the tent near the Douglas-fir
- ➢ Initiate discussion (while getting into gear):
  - Q: What kind of tree will we be climbing?
  - A: A Douglas-fir can be identified by its deeply furrowed, thick bark.

        - Note the reddish-brown cones on the ground and two additional characteristics: the apex bud at the end of the branch and the "mouse tail" pieces along the cone
    - Q: What levels of the tree will we be climbing today? Does anybody know all three layers of a forest?
    - A: The understory to the canopy. Three layers include: floor, understory, and canopy.
        - Explain: As we climb we will see visible changes between the understory and the canopy.
    - Q: Does anyone know what a hypothesis is?
    - A: A hypothesis is an educated guess based on observations.
    - Q: "Let's make a hypothesis right now!" What kind of changes might we see between the canopy and the understory as we climb? Why?
        - Allow students to share ideas. Use questions to probe their logic.
    - Get students excited to begin tree climb with Pacific Tree Climbing Institute.
- ➢ Persuade students to make note of observations, changes and new things that they have never seen before, also instruct students to make note of the temperature gauges on the tree as they climb to observe the change in temperature.
- ➢ Make sure to give them your full attention for the safety talk.

Step 2: *Climbing Safety Orientation* *Time: 5 min*
Facilitated by PTCI Staff

- ➢ Ensure that all students empty pockets and leave loose belongings on the ground.
- ➢ Check that hair is tied back.
- ➢ Reassure nervous students and encourage them.
- ➢ Complete suiting up.

Step 3: *Climb the Tree* *Time: 30-40 min*

- ➢ Check that students are following safety instructions, take photos.
- ➢ Track timing and make sure that group is running on time.
- ➢ Remind students to climb in silence, and to take note of the changes they observe as they climb.
- ➢ If students are being loud, engage students in quiet conversation about what they see, and ask them if there is anything new they see.

Step 4: *Descent and Removal of Harnesses* *Time: 15 min*
As group removes harness, continue discussion asking about differences in the layers of the tree. Once everyone is out of their gear and gathered, thank PTCI instructors and debrief hypothesis from beginning. It is important to note that it is the facilitator's responsibility to give the PTCI members a fifteen minute warning so that students can descend and move on to the next station.

Debrief Questions

- Q: How was it? How do you feel?
- Q: What changed from the ground to the canopy? What stayed the same?
- A: Foliage gets denser as you go up, the branches get smaller, it got brighter (more sun), temperature dropped as we climbed.
- Q: How did the range of your senses change as you climbed the tree? For example, could you hear more or see more?
- A: It becomes easier to see further when higher up because you are able to see over the trees instead of through them. The sound of Lookout Creek is clearer.
- Q: How might an animal capitalize on the tree habitat?
- A: Species could use the tree to easier spot prey or predators. They may also use it to hide from predators.

Station Two
Karin Rita Gastreich's Studio

Developed by: Kennedy Potts and Artesia Hubbard

Time: 75 minutes

Overview

This activity introduces middle schoolers to the vital role observation plays in both science and the arts. Through individual reflection in 'sit spots' and small group activities, students will hone their observation skills. The purpose of this lesson is to provide students with tools that will allow them to practice observation effectively and be able to integrate them into both scientific and artistic pursuits throughout the remainder of their lives. It also aims to give students a chance to explore their creativity and use their senses. The goal is to build a strong connection between the student and nature using the beautiful old growth forest of H.J. Andrews as a medium.

Rationale

The skill of observation can be integrated into an array of professions or life paths concentrated both in science and in the humanities. Students may only be familiar with utilizing observation through scientific practices; however, it is important to understand the skill of observation as being necessary for success in a variety of disciplines, including visual art and literature. We hope to emphasize the connections between long term artistic reflections on human interaction with the environment and scientific research. By giving students the opportunity to sharpen their observation skills, we can ensure that they will be able to apply this skill to any long term future goals or careers they may pursue.

Learning Outcomes

By the end of this lesson, middle schoolers will be able to:

1. Discuss the importance of observation skills in both science and writing.
2. Identify three ways to hone observation skills.
3. Use art and observations to build a personal relationship with nature with the aid of sit spotting and a journaling activity.

Links to Standards

Oregon Common Core State Standards (CCSS) Grade 6: Literature

Key Ideas and Details 6.RL.2:

> Determine a theme or central idea of a text and how it is conveyed through particular details.

Materials Needed

- ➢ Provided Field Notebooks
- ➢ Writing utensils
- ➢ HJA artist materials (i.e. paintings, photographs, poems, stories created by long term ecological reflection artists working at H.J. Andrews (http://andrewsforest.oregonstate.edu/lter/research/related/writers/template.cfm?next=wir&topnav=169). This link takes you to reflections of writers who have visited HJA.
    - ○ Hard copy of Karin Rita Gastreich's forest story (attached in Appendix D)
- ➢ Douglas-fir cones (as similar as possible), one for each student

Background Information

Long Term Ecological Reflection and the Humanities at H.J. Andrews

H.J. Andrews has specifically integrated multiple aspects of the humanities into the work done at their organization, because they believe that they hold important similarities with science and that they are necessary to include in environmental study in order to completely understand our relationship to our planet and its ecosystems. Part of this Long Term Ecological Reflections initiative involves residency and fellowship programs for writers and other types of artists to observe and document their perspective of the forest and the way that humans relate and interact with it. During their time at HJA, artists interact with researchers and visit specific Long Term Ecological Reflection plots, eventually documenting their experience in a "Forest Log." We will be integrating H.J.A.'s concept of Long Term Ecological Reflection by introducing the students to some of the material created by artists there. In turn, we hope to foster the students' critical thinking by asking them to identify ways the artist uses observation much like the scientists at H.J.A. do. Having an example of art produced at H.J.A. will also provide context for how the humanities may be practiced in the forest, and will serve as one introduction to the sit spot activity we will be implementing later in the lesson.

Author: Karin Rita Gastreich

Karin Rita Gastreich is an Associate Professor of Biology at Avila University in Kansas City, Missouri, as well as a published author. During the spring of 2011, she was selected to participate in the writer's residency at H.J.A., where she took part in their Long Term Ecological Reflections (LTER) project. During her time at H.J.A. she kept a daily journal in which she documented her personal experiences, reflections, observations, feelings, and field notes. Her reflective writing provides excellent examples of observation as a tool to use for both the arts and the sciences.

Gastreich's Forest Story Background

The provided text was taken from Gastreich's journal entry dated Wednesday, May 18th, 2011, where she documented examples of detailed observations and reflections, as well as a relevant poetry sample that can be used as an introduction into the observation and sit spot lessons. Her journal entry was revised here to be told in story form to provide a more engaging, relatable, and thought provoking experience for the learners as they listen. It captures an experience of walking through the magnificent old growth forest and provides examples of the possible observations that can be made using the human senses (sight, smell, touch, sound). It provides deep imagery of plants, animals, sounds, smells, colors, and shapes to refer to as important elements to observe while sit spotting. This text provides an opportunity to explain the importance of "listening" to the forest in order to enhance the observations of the students. This text is to be used as an introductory tool for developing the use of observational skills among the learners and initiating a sense of imagination and wonder for what can be observed in nature.

> Note: Aside from Gastreich's work at H.J.A. as a LTER participant, there are many other authors that can be utilized for this lesson plan, therefore you may choose a different author if desired.

Methods: Sit Spotting (taken from *Coyote's Guide to Connecting with Nature*)
A sit spot is a journaling activity in which one spends time alone in nature and documents any observations. Ideally, this is repeated on a regular basis in a designated area for specified amounts of time. Sit spots engage the senses and foster both creativity and personal reflection through observation. The activity also teaches the importance of documenting evidence, as one can observe interesting and possibly scientifically important changes over time (i.e. as shown in Rachel Carson's *Silent Spring* [see below]). This activity connects to our learning outcomes both by practicing the skill of observation and by nurturing human connection to the natural world. This activity will provide students with skills for making deep observations and thinking critically and creatively about the environment to persuade future participation in environmental settings.

Importance of Observation and its Connection to Multiple Disciplines
In order to teach the students the importance of observation, instructors first need to understand its implications and uses themselves. Scientists use observation in the scientific method, artists use it in order to tell a story about a place or paint a picture of it. Doctors observe their patients' symptoms to deduce their illness, dancers observe their instructors to learn new movements, and farmers observe their plants to determine if any conditions must be changed to improve their growth. The environmentalist observes animals and ecosystems in order to understand causes of any alterations and determine possible solutions to any encountered problems [see below]. Whatever the discipline, observation is a skill that is essential to cultivate. As instructors we are responsible to communicate this fact to the students in order to show them why the development of observation skills is so important.

Rachel Carson's *Silent Spring*
In the 1940s, Rachel Carson used observations of the animals in her neighborhood to explain the disastrous effects that chemicals, particularly DDT, have on the ecosystem. The practices of observation and documentation Carson used to come to her conclusion, distributed to the public via her book *Silent Spring*, was an incredibly important moment in the environmental movement. This anecdote may be used to help students further understand the importance and usefulness of observation skills, especially as connected to the environment.

Activity Description

Step 1: *Making Observations* *Time: 15 min*

(Adapted from Laws et al. 2012. *Opening the World through Nature Journaling*, 2nd ed. To Each Its Own. CA Native Plant Society. Pp. 34-35.)

- ➢ Deposit the Douglas-fir cones on the ground in front of the students.
- ➢ Instruct each student to pick one from the pile.
- ➢ Direct students to take 5 minutes to individually draw their cone in their journals.
- ➢ Direct students to focus on shape, length, size, and detail.
- ➢ After 5 minutes, have students redeposit cones in a pile and exchange their drawings

- ➢ Challenge students to match the drawings with the correct cone (the one the person who drew it must have had).
- ➢ Inform students not to match their own drawing/cone.
- ➢ After 5 minutes, have students return to their personal drawing.
- ➢ Go around to each student in the circle and have them tell the group if they matched the drawing correctly.
    - ○ Instruct students to explain how they identified whether it is or is not the correct image.
    - ○ If it is not the correct one, have each student tell the group which one they think is the correct cone.
- ➢ Use 5 minutes to debrief the activity:
    - ○ Q: Why do you think we did that activity? What did it teach us?
    - ○ A: It is important to understand detail and accuracy as important parts of observation for scientists, artists, and other professionals who use extreme detail whenever they document their observations.

Step 2: *Exploring HJA Artists* *Time: 10 min*

- ➢ Circle the students.
- ➢ Briefly summarize the Long Term Ecological Reflection program housed at H.J.A. (this information can be found under Background Information).
- ➢ Introduce the chosen H.J.A. author with a very quick description of their background.
- ➢ Request that they make note of Rita's observations as they listen, and try to identify to themselves any natural object (plant, animal, element), sound, color, or feeling that Gastreich identified during her narrative.
- ➢ Read the text to the students in story form
- ➢ Once story is finished, engage students with questions to relate story to observation skills.
    - ○ Q: What kind of objects, sounds, smells, or feelings did she record using her senses?
    - ○ A: She feels temperature, texture, and emotion. She hears forest sounds. She uses her eyes to see colors, shapes, and interactions of the many pieces of the forest.
        - ■ This activity is intended to encourage the students to use their senses to "listen" deeply to the forest in order to make unique observations. This is also aimed at introducing students to utilize their feelings and emotions to enhance their observations and experience.
- ➢ Summarize that Gastreich used her senses in order to notice more unique and interesting objects and enhance her observations.
- ➢ Ask why observation is an important skill to have as a scientist, an artist, an environmentalist (reference Rachel Carson's work), and even just as a "present" living being on this planet.

- ➢ Ask students what professions or life paths they are interested in pursuing and how observation might be an important skill for that field.
    - Engage students in their individual career goals and ask them what observation skills they would need in said profession to be successful.
    - Engage the idea that both scientists and artists require observation.
- ➢ Transition to sit spot by saying: "Who thinks they have pretty good observation skills? Really good observation skills? Ok, we'll test that now. Today we're going to sharpen our skills of observation by taking some time to sit and experience this awesome forest we're in! We can all practice being scientists and artists."

Step 3: *Sit Spot Activity* *Time: 35 min*

- ➢ Introduce the activity by telling a story about a sit spot experience (explain what a sit spot is [see **Background Material: Sit Spots**]) to illustrate how the activity works and what students should be getting from the experience.
    - If you have engaged in a sit spot, convey how fun the activity can be and try to inspire the students to continue this practice after the field trip through telling them what interesting and exciting observations you have made.
    - Remind students to use their senses during the activity (like Gastreich did), looking closely at objects, listening for forest sounds, smelling, and touching the things around them.
    - Direct them to do their best to forget everything else and focus on the place they are currently in.
- ➢ Direct the students to disperse along the path with their journals and find a place to sit that isn't too close to any of their peers.
    - Set safe boundaries.
    - Students should not be able to see each other if possible. Perhaps have them facing different directions.
    - If students are too close or are being distracted by one another, you may have them move to a more secluded spot, where that individual cannot interact with others.
- ➢ Allow the students 30 minutes to sit, observe, journal, and draw. Do not be walking around among them as they sit spot. Sit quietly on your own, joining them in the sit spot activity. Model the behavior you wish for them to perform.

Step 4: *Story of the Day* *Time: 10 min*

- ➢ Gather the students together to sit in a circle.
- ➢ Start first by sharing what you observed. Be super detailed, set the standard.
- ➢ Going around the circle, ask each student to share what they wrote and drew through an observation, a picture, a moment/feeling, etc.

- ➢ Consider these further questions to facilitate discussion (allow students to direct this flow, however, as long as the conversation stays useful/educational):
    - Q: "What did you observe that surprised you?"
        - ➢ "What would you have expected and why?"
        - ➢ "Explain what you think was happening."
        - ➢ "Why was it surprising?"
    - Q: "What methods did you use to observe?"
        - ➢ "How might a scientist use these same methods?"
        - ➢ "How might an artist use these same methods?
        - ➢ "Why was it surprising?"
    - Q: "Did you see anything new that you've never seen before? Or did you see something that you have seen before but don't know what it is?"
        - ➢ "What do you think it could be/ Why do you think this occurred?"

Step 5: *Wrap Up and Departure to Next Station* *Time: 5 min*

- ➢ Ask them to summarize the key thing they learned at this station.
- ➢ If no one mentions it, restate the importance of observation skills in science, art, environmental fields, and life.
- ➢ Ask students if they enjoyed sit spots and plan to continue the practice in the future (encourage them to do so-frame it as a fun activity they can be excited to engage in routinely).
- ➢ Gather sit spot materials.
- ➢ Head to next station.

Additional Reading/Resources

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Station Three
Life After Death: Jerry Franklin & Mark Harmon's Lab

Developed By: Paige Book and Garrett Davidson

Adapted From:
"Coyote's Guide to Connecting with Nature" and Emily Chi's "Never-Ending Nutrient Cycle" field trip lesson from the 2009 Canopy Connections Curriculum.

Time: 75 Minutes

Overview
This station introduces students to the importance and role of decomposition. Through a series of individual and group activities, students will learn about the stages and timescales of decomposition based on Mark Harmon and Jerry Franklin's famous 200 year Long Term Ecological Research experiment as well as learning about different kinds of organisms that aid in the process. The lesson also gives students a chance to explore and observe on their own, and incorporate journaling to connect and inspire students to tune into their surroundings. Learning the etymology of terms such as autotroph and heterotroph will be integrated into the lesson as well as an introduction to fungi and types of decomposers. Additionally, distinctions between gymnosperms and angiosperms will also be explained. The lesson concludes with sharing findings and observations and reviewing any misunderstood concepts with the goal of understanding and recognizing forest decomposition on a nature based timescale.

Rationale
Old growth forests such as H.J. Andrews may seem stagnant and look similar each time someone visits. A main goal of learning about decomposition is to encourage students to understand forests as systems that constantly recycle nutrients over timescales much longer than human lifetimes, and how forests change and look different as time progresses. We aim to emphasize how decomposing logs provide habitat and nutrients for many types of organisms, which is vital to maintaining forest biodiversity. Both living and dead organisms are key to the health of an old growth forest and our lesson aims to broaden students' perspectives about what goes into making a healthy forest ecosystem, aiming to inspire and elicit feelings of awe, amazement, and appreciation for the world around us. Emphasizing the interconnections and interdependence of the old growth forest will illustrate to students the many organisms that rely on decomposition for habitat and food, while highlighting the importance of nutrient cycling for plant growth. Without decomposition, nutrients would not be replenished back into the soil, and eventually nothing would be able to grow. Vital to an old-growth forest, learning about decomposition will help students see the bigger picture, especially in regards to comparing the lifetimes of humans and trees.

Learning Outcomes

By the end of this lesson, students will be able to:

1. Recognize different stages of decomposition and distinguish stages using vocabulary learned throughout the lesson.
2. Describe two reasons non-living trees are important to an old-growth forest ecosystem.
3. List two important ecological roles that dead trees play in an old growth forest.
4. Be able to explain the difference between autotrophs and heterotrophs.

Links to Standards

Next Generation Science Standards

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release (gas, liquid, or solid) waste matter back into the environment.

Materials Needed

- ➢ Set of laminated "DECAY" cards. Photos can be found in Appendix F.
- ➢ Provided Field Notebooks and pencils.
- ➢ Cards for "Two Truths and a Lie" game.

Background Information

200 Year Log Decomposition Experiment and Long Term Ecological Research

In 1985, Mark E. Harmon started a long-term ecological research experiment at the H.J. Andrews Experimental Forest focusing on the decomposition process and roles of non-living trees of the forest floor. Western Red Cedar, Douglas-fir, Pacific Silver Fir, and Western Hemlock trees were felled and placed throughout the old-growth forest. Density, moisture, and nutrient content were all periodically measured to determine and measure decomposition rates and status. Harmon and others were able to conclude within the first 5 years of the experiment that logs are capable of absorbing 25 percent water, which later leaches back into soil with carbon and nitrogen concentrations ten to twenty times higher than normal rainwater. Also within the first 5 years, hundreds of species such as fungi, mites, bacteria, detritivores, and decomposers take advantage of the nutrient rich logs as habitat. Note that different tree species decay at differing rates, for example Pacific Silver Fir only takes about 15 years to decompose half of its organic matter while the Western Red Cedar takes much more time. So far, the results of this study illustrate how logs are very important to old growth forests as they provide habitat, nutrients, affect water distribution, are a source of nitrogen for growing plants, and stimulate nutrient cycling on the forest floor.

Vocabulary

Decomposition: State or process of rotting, decay.

Decomposer: An organism, usually a bacterium or fungus that breaks down the cells of dead plants and animals into simpler substances.

Three main types of Decomposers: Fungi, bacteria, detritivores.

- ➢ **Fungi**: Organisms that live by decomposing and absorbing the organic material in which they grow, comprising the mushrooms, molds, mildews, etc.
- ➢ **Bacteria**: Microscopic living organisms, usually one-celled.
- ➢ **Detritivore**: Heterotrophs that obtain nutrients by consuming decomposing plant and animal parts (earthworms for example).

Heartwood: Part of tree trunk found in the middle; proves to be dense and is often used for hard timber.

Sapwood: Contains the vascular tissues of the tree soft layer between bark and heartwood.

Bark: A protective layer of dead corky cells on the outside of the stems of woody plants.

Snag: A standing tree that is no longer alive.

Nurse log: A seedbed created by a dead/decaying log

Detritivore: An organism who uses organic waste as a food source. Feeds on and breaks down dead plant or animal matter, returning essential nutrients to the ecosystem. Includes bacteria, fungi, insects, worms. Are primary consumers.

Autotroph: Organism that can produce their own food from substances available in their surroundings using light.

Heterotroph: Cannot synthesize their own food and rely on other organisms (both plants and animals) for nutrition.

Mushroom: The fleshy, spore-bearing fruiting body of a fungus, typically produced above ground on soil or on its food source (decomposing logs, for example).

Etymology of autotroph and heterotroph:

- ➢ **Auto-** : self
- ➢ **Hetero-** :other, different
- ➢ **-troph**: food, nutrition, nourishment

The Six Stages of Decomposition:

Note: there are six official stages of decomposition, but the DECAY ordering game only covers the five stages that are most easily differentiated.

1. No moss, bark is still present, wood is clear may have slight blue tint.
2. An increase in decay, bark becomes damaged; heartwood stays healthy. However, sapwood begins to decay.
3. Log itself begins to decay into bark and stubbed branches, wood becomes damaged.
4. Almost all bark is no longer visible, can no longer support own weight, sapwood is no longer present and heartwood begins to crumble into smaller pieces

5. Log no longer exists in the log shape, begins to turn into a powder where you can see the outline of the decaying matter.
6. It takes two to four hundred years before a log is completely decomposed, the decaying organic matter of the log is now present beneath the soil below.

Decomposition

Decomposition is the process by which organic matter diffuses into nutrients and minerals that leach into the soil (Neeley 2003). The decomposition of woody debris in forests is an essential service for a healthy ecosystem as rotting wood provides habitat for many microorganisms, as well as other species of the forest (Neeley 2003). For example, rotting wood houses insects such as bark beetles, carpenter ants, fungus such as ectomycorrhizal fungus (root fungus), amphibians, and microorganisms such as rhizobium bacteria and agrobacterium (Neeley 2003). In addition, snags or trees that are dead and still standing provide homes for birds such as woodpeckers and wrens, red squirrels, and raccoons (Washington Department of Fish and Wildlife). When trees fully decompose, they return their stored nutrients to the soils beneath. However, before this process takes place, the decomposing log provides a natural seed bed in which many surrounding seeds germinate (Neeley 2003, Franklin et al. 1987). The decomposition rate of a tree can be described in three main stages beginning with biological respiration, then leaching, and finally fragmentation (Zhou et al. 2007). In conclusion, the decomposition of a log influences the environment in many ways, whether it houses organisms or cycled nutrients of the soil, the life and death of a tree has a profound impact on its ecosystem.

- ➢ There are 6 main steps a trees goes through before returning back to the soil. It is important to note that all logs go through these steps, yet decompose at different rates, as seen in the log decomposition study below (Mark Harmon).

Activity Description:

Step 1: *Introduction and Frontloading* *15 min*

This station is located on the Discovery Trail and starts at the wooden Discovery Trail sign. If entering the trail from the road remind students that they are re-entering the beautiful old growth forest and be sure to keep all of your senses engaged and use your best observation skills. The beginning of the lesson starts with a conversation about decomposition, where vocabulary terms and questions about decomposition are frontloaded to students to get them in the right mindset. We suggest using the first fallen tree across the trail to start discussion.

- ➢ Remember to point out and use real life examples as teaching tools whenever opportunities arise. Pointing out examples of vocabulary may help students begin to recognize signs of decomposition when they get the chance to observe on their own.
- ➢ Almost immediately after starting to walk on the trail there will be a giant log lying over the trail that's been cut so people can walk by. Stop at this first log to start a conversation about decomposition.

- Q: Can anybody tell me something about decomposition/ does anybody know about or ever heard of decomposition?
- A: Decomposition is a process of rotting and how a forest recycles and reuses nutrients.
- Q: About how long does a tree live?
- A: Depends, but most trees live well over 100 years! A few examples are the Western Hemlock, which lives about 400-500 years, the Western Red Cedar living up to 1,000 years, Douglas Firs, which commonly live up to 500-1000 years, and Pacific Yews, which live about 300 years.
- Q: How long does it take for a tree to completely decompose?
- A: Although decomposition rates differ depending on species and conditions, the studies by Jerry Franklin and Mark Harmon suggest that it takes about 200 years.
- Q: How do we know this if people don't live that long? Does anyone have any ideas about ways to study decomposition (use this as a transition to talk about the 200 year LTER study).
- A: Observation and Experimentation!
- Q: What may be some obstacles and challenges we would face when trying to study decomposed logs?
- A: Humans do not live as long as trees, and nowhere near as long as it takes for them to decompose.
- Q: Has anybody ever heard about Jerry Franklin and Mark Harmon's 200 year log decomposition study or know who Jerry Franklin and Mark Harmon are?
- A: They are scientists who started an experiment here at H.J. Andrews to study just what we have been talking about - decomposition of the forest floor! To avoid many of the problems we've been talking about regarding how long it takes for trees to decompose, which makes it hard for humans to study, they started an experiment that is scheduled to last 200 years!! The experiment is designed so that it can be passed on from scientist to scientist in efforts to study on a nature-focused timescale rather than a short experiment that requires extrapolation. Talk about 200 year experiment in more depth. Emphasizing the difference between human and nature timescales.
- Q: There are three different types of decomposers, can anybody name some?
- A: The three types of decomposers are Fungi, bacteria, and detritivores. Definitions are above in the vocabulary section.
- Q: Are there any examples of decomposition that we can see right now?
- A: How about this log we're standing on! Students will get the chance to look around and find examples further in the lesson along the trail.
- Q: Why would decomposition and dead trees be important in an old growth forest?

- A: Because it recycles nutrients and returns those to the soil while also providing habitat for an abundance of organisms.
- Q: Is it good to remove dead trees from the forest floor?
- A: No, trees and snags provide habitat for many different species. Additionally, logs retain moisture that can slowly leach back into the soil, helping provide water even when the weather is dry.
- Q: What is LTER?
- A: An acronym for Long Term Ecological Research.

Step 2: "*DECAY" Ordering the Stages of Decomposition* *20 min*

- ➢ Although there are six official stages of decomposition, this activity focuses on five clearer stages to avoid confusion when ordering the cards. This activity takes place in the middle of the discovery trail, where the path widens.
- ➢ The goal of this activity is to have students critically think about what different stages of decomposition may look like, which will help later on in the lesson when they will be searching for their own example.
- ➢ Ask group: Are there different stages of decomposition? What are some predictions about what they might look like?
- ➢ Use the questions to start a conversation about characteristics of trees and use as opportunity to weave in vocabulary - bark, sapwood, heartwood, snag, nurse log, detritivore, autotroph, etc.
- ➢ Encourage students to use vocabulary to describe predictions about how a log may decompose.
- ➢ Now, talk about each step as described on laminated "DECAY" cards before passing them out to students.
    - 1: Bark and wood are strong, no moss. 2: Bark becomes damaged, sapwood begins to decay while heartwood remains healthy. 3: Wood becomes damaged and log itself begins to decay while bark becomes weak. 4: Almost all bark is no longer visible, sapwood not present and heartwood starts to crumble. 5: Log is completely decomposed and decaying organic matter from the log is beneath the soil.
- ➢ Take the "DECAY" cards out of backpack and hand them out to students in a random order. Let them know that the images are taken directly from Jerry Franklin and Mark Harmon's experiment.
- ➢ Tell students to analyze their card and imagine what stage of decomposition it may be in.
- ➢ Now, have the students try to arrange themselves/ the cards from least to most decomposed. Cards will spell out "DECAY" if the students line up in the right order.
- ➢ Ask about why they chose that particular way and have them explain the logic behind the order they chose.

- ➢ Once the correct order (should not take very long) is established, a journaling and observation activity is next.

Step 3: *Decomposition Observation and Journaling* *20 min*

- ➢ Now that students know a little bit about the stages, they will get a chance to find and observe examples of decomposition on their own terms and add to their field notebook.
- ➢ Set boundaries (we suggest the log used in opening discussion and the creek bed) and remind students to stay on the trail.
- ➢ Explain that students are to go out and search for examples of decomposition or other vocabulary terms in the lesson such as snags or nurse logs while remaining on the trail.
- ➢ Let the students roam up and down the trail until they have found an example of decomposition they want to journal about or the stage that's on the card they held during the "DECAY" activity.
- ➢ When they have found an example they like, have them sit and journal about it, whether it means writing down observations or drawing what they see.
- ➢ Encourage them to focus on the clues of decomposition we just learned about and reasons they chose this particular example (is the heartwood still strong? Bark gone?).
- ➢ When everybody is sitting down and all students have been journaling for about five minutes, walk up and down the trail gathering students at the big log at the beginning of the trail once more.
- ➢ Now, the entire group will walk along the trail and stop at each location a student was sitting. Have that student share their journal entry about the real life example and have a brief group discussion. This way each student gets a chance to share, many stages of decomposition are covered, and instructors can point out any great examples that may have been overlooked by students.
- ➢ Engage students with discussion questions:
    - Q: Where did you go to find this?
    - Q: How did you find it?
    - Q: What did you notice about this that is different than its surroundings?
    - Q: What's going on in this stage of decomposition?
    - Q: How old do you think this tree is?

- ➢ If preferred, have students arrange the stages of decomposition pictures in order again. Were students faster this time? Ask the students what they learned from the section and facilitate discussion, in order to evaluate if students understood concepts taught within the lesson.
- ➢ Tell students to continually look for signs/stages of decomposition throughout the rest of the trip, to reinforce what they had learned during this section of the field trip.
- ➢ Gather in a circle and go over/review the three types of decomposers (fungi, bacteria, and detritivores).

Step 4: *Two Truths and a Lie* *15 min*

- ➢ For the final activity in this lesson, pairs of students will receive species cards with an image and three statements, two will be true and one will be false. Students will try to find the habitat the species on their card lives and try to point out the lie. Similar to the above activity, the entire group of students will walk up and down the path together until reaching the spots where pairs think their species could live.
- ➢ Before starting the activity and splitting into pairs, lead a discussion about the etymology of autotrophs and heterotrophs and their differences.
    - Q: Can anybody explain to me the difference between an autotroph and heterotroph?
    - A: Autotrophs can make their own food out of inorganic substances (the sun) while organisms that break down organic matter are called heterotrophs.
    - Explain: In order for decomposition to be possible, we need organisms that have the ability to break down organic matter so that bacteria and other microorganisms can further carry out the process of decomposition.
- ➢ Hand out species cards to pairs of students (**Appendix G**) (also set the same boundaries as the previous observation activity) and instruct students to go over the information on their provided card.
- ➢ Instruct each pair to use the information on their card to try to find a place they see as a potential habitat for their species.
- ➢ After all pairs have found potential habitats, have students write observations of the habitat that they encountered in their journal, Was the habitat moist, was there presence of leaf litter etc.? Gather all students in a circle and ask each pair where they think their species might be located within the forest and if they were actually able to find their species. Have the pair share thoughts about how the habitat can influence what they consume and what they are classified as (autotroph or heterotroph).
- ➢ As a group instruct students to go around the circle and share the truth/lie statements on their card while the rest of the group determines which is true or false.
- ➢ Guide students to the correct answers through the art of questioning if needed.

Step 5: *Recap and Departure to Next Station* *5 min*

- ➢ Have students form a circle and review major concepts (heterotrophs vs. autotrophs, 3 types of decomposers, and importance of tree decomposition in an old-growth forest). Answer any questions students may have about the lesson.
- ➢ This is also a chance for students to share, perhaps a journal entry or short personal story if they did not get the chance previously.
- ➢ Have each student share something they learned through the lesson or what was most interesting to them.
- ➢ Emphasize the importance of leave no trace and not taking from the forest, because all material needs to be recycled to keep all the nutrients available for the forest.

➢ Gather materials (if not already done) and move onto next station.

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Station Four
Naming and Knowing: Plant I.D. and Biodiversity

Developed by: Allison Humphrey and Skyland Worman

Adapted from:
This lesson was adapted from "Coyote's Guide to Connecting with Nature". Inspiration was also taken from the Canopy Connections 2014 dichotomous key exercise.

Time: 75 minutes

Overview
This activity introduces students to the plants around them through an exploration of biodiversity in old growth forests. Students will learn how to use a dichotomous key in order to identify a few important plant and tree species present in the H.J. Andrews Forest. In order to understand the more complex processes that occur in a forest, it is essential to first learn some of the key parts of the system, i.e. trees, shrubs, and animals. This station will explore the concept of biodiversity within a forest ecosystem, focusing mainly on the diversity of trees and shrubs. Students will use their observations and take notes to strengthen their senses and learn how scientists identify and categorize plant organisms.

Learning Outcomes
By the end of this station, students should be able to:

1. Use a dichotomous key.
2. Identify at least four plant species native to the McKenzie River watershed.
3. List two ways humans use or interact with any of the identified species.
4. Discuss at least one reason why biodiversity is important in the McKenzie watershed.

Rationale
Growing up in the Pacific Northwest, children have an incredible opportunity to explore the region's rich and biologically diverse old growth forests. Unfortunately, not all parents have the time or desire to take their kids exploring, and schools tend to focus their education in a classroom with at most a few plants in the window. Guiding students to discover and think critically about local species through their own observations within an experiential learning space, allows them to explore their own relationship to the natural world. By learning how to distinguish various plant species in the McKenzie watershed and the importance of such biodiversity, students will be introduced to the complexity of a forest ecosystem and how their own lives fit into the web of life.

Biodiversity is one of the major themes in the long term ecological research at HJ Andrews. Understanding biodiversity is an important aspect in recognizing ecological health. Engaging students in experiential learning as scientists builds upon H.J. Andrews Long Term Ecological Research themes while stimulating attitudes of empathy, excitement, and concern for the environment and its current associated issues.

Pre-Trip

- ➢ Collect branches/cones/leaves off ground, including; Western Red Cedar, Douglas-fir, Pacific Yew and Big Leaf Maple.
- ➢ Make sure all materials for Web of life and the keying exercise are on hand.

Materials Needed

For Plant Identification:

- ➢ Small branches/cones or images showing clear examples of traits the key uses to identify
- ➢ Tree characteristics printed on backside of key
- ➢ 12 Dichotomous keys laminated (attached to appendix)
- ➢ copy of Oregon Shrub and Tree Guide for facilitator to show

For Web of Life game:

- ➢ 8-10 Species Pictures
- ➢ Ball of yellow yarn (the sun).
- ➢ Field journals
- ➢ Sit spot squares (if they choose to sit)

Background Information

Biodiversity

A contraction of "biological diversity," generally refers to the variety and variability of life on Earth. One of the most widely used definitions defines it in terms of the variability within species, between species, and between ecosystems. The diversity of organisms is part of the natural processes essential to the survival of all living things. Species diversity, the number and variety of species in one area, is one indicator of ecological health and changes with respect to forest structure and complexity. It is an essential component of nature and it ensures the survival of all species by providing food, fuel, shelter, medicines and other resources to each other, creating massively interconnected network of life. Since humans are a part of this web of life, our survival is completely reliant on biodiversity. Biodiversity is not evenly distributed, rather it varies greatly across the globe as well as within regions. Among other factors, the diversity of all living things depends on temperature, precipitation, altitude, soils, geography and the presence of other species. All species of life are constantly changing and adapting to new environments and situations, in an attempt to spread genes and establish their role on this planet. Every time a new species is created through evolution, another string is added to the web and biodiversity increases.

HJ Andrews is a highly biodiverse ecosystem and is defined as a temperate coniferous old growth rainforest. This unique ecosystem is home to "thousands of species of insects, 83 bird species, 19 gymnosperm species, and 9 species of fish" (HJ Andrews, 2008). Complexity and biological diversity are essential components of an old growth forest which provide habitats for some of the rarest species left on earth. The Northern spotted owl is one of these rare and endangered species that lives here in the canopy of the McKenzie watershed.

Biodiversity is extremely important to people and the health of ecosystems. A few reasons are:

- ➢ Biodiversity allows us to live healthy and happy lives. It provides us with an array of foods and materials and it contributes to the economy. Without a diversity of pollinators, plants, and soils, our supermarkets would have a lot less produce (National Wildlife Federation).
- ➢ Most medical discoveries to cure diseases and lengthen life spans were made because of research into plant and animal biology and genetics. Every time a species goes extinct or genetic diversity is lost, we will never know whether research would have given us a new vaccine or drug (NWF).
- ➢ Biodiversity is an important part of ecological services that make life livable on Earth. They include everything from cleaning water and absorbing chemicals, which wetlands do, to providing oxygen for us to breathe—one of the many things that plants do for people (NWF).
- ➢ Biodiversity allows for ecosystems to adjust to disturbances like extreme fires and floods. If a reptile species goes extinct, a forest with 20 other reptiles is likely to adapt better than another forest with only one reptile (NWF).

Ecosystem

A biological community of interacting organisms in their environment; i.e. everything that exists in a particular environment. Temperate is an area with a mild climate. Conifer is a type of tree that produces seed bearing cones and in most cases, is evergreen. Evergreen denotes a plant that retains its leaves or needles throughout the year, unlike a deciduous plant that loses its leaves in the winter.

Old growth

Old growth refers to the climax stage, or last "stable" stage of a forest.

Dichotomous Key

A tool used for species identification and re-acquainting ourselves with the world around us. It is a method of categorization that works by starting at the broadest category (such as Evergreen or Deciduous) and eventually narrowing down to a specific genus or species. The species can fit only one of the two character descriptions such as: 1a. Needles are flattened (do not roll in hand), 1b. Needles are round. Dichotomous keys are ubiquitous to the field of biology and are used to identify plants, animals, and fungi (2014 Canopy Connections Team).

Trees that will be covered in lesson (Description and Use)

Douglas-fir ***Pseudotsuga menziesii***

Morphology

- Coast Douglas-firs commonly grow up to 250 feet in old-growth forests and can reach 5 to 6 feet in diameter. These massively magnificent trees have a clearly conic crown.
- Needles are about 1 inch long with a blunt tip. Green on top with two white bands below, and are spirally arranged. May sometimes look obscurely 2-ranked.
- Buds are larger with pointed tips and reddish-brown overlapping scales.
- The Bark is variable; gray to reddish-brown, with deeply furrowed fissures on the trunk.

Sources: "Manual of Oregon trees and shrubs" (page 69) and "The Gymnosperm Database" (Web)

Habitat

- A major component of the forests of western North America since the mid-Pleistocene.
- The latitudinal range of Douglas-fir is the greatest of any commercial conifer of western North America.
- Douglas-fir seeds provide food for a number of small mammals, including chipmunks, mice, shrews, and red squirrels. Many songbirds eat the seeds right out of the cone, and birds such as northern spotted owls rely on the old-growth forests of Douglas-firs for cover.
- Reaches its best growth on well-aerated, deep soils, will not thrive in compacted soils.

Sources: Forest service silvics of North America Volume 1 "Pseudotsuga menziesii"

Uses

- Douglas-fir is one of the world's most important and valuable timber trees. Many of the students will most likely have lived in a house of which Douglas-fir was an essential building material. The revenue made through timber production has funded many projects in Oregon both public and private.
- Used extensively for ties, poles, piling, flooring, and general construction.

Sources: Forest service silvics of North America "Silvics manual" Volume 1

Citations for Images:
http://www.nps.gov/fire/wildland-fire/resources/images/olympic-np-large-douglas-fir-tree-trunks.jpg (Left)
https://www.extension.iastate.edu/forestry/iowa_trees/tree_id_photos/FIR_DOUGLAS_leavesMed.jpg (Middle)
http://www.gaiansoul.com/wp-content/uploads/2011/03/DougFirCone1.jpg (Right)

Western Hemlock ***Tsuga heterophylla***




Morphology

- Large trees are 125 to 200 feet tall, and 2-4 feet in diameter; with a pyramidal crown of somewhat pendulous branches and fine foliage.
- Leaves are ¼ to ¾ inches long, linear, flat, and vary in length along the twig.
- These trees are known for their distinct cones which are ¾ to an inch long and reddish-brown at maturity.
- Bark is more of a darker gray than the Douglas-fir, with much smaller furrows.

Sources: "Manual of Oregon Trees and Shrubs" (Page 72)

Habitat

- Western Hemlock is closely associated with temperate rain forests, and most of its range is less than 100 km from the Pacific Ocean.
- It is an extremely shade tolerant tree which typically grows up under the canopy of other conifers such as Sitka spruce or Douglas-fir, where they can persist for decades waiting to exploit a gap in the canopy.
- Because of the trees' shallow root systems, they are highly susceptible to being toppled over by wind throw.

Sources: Forest service silvics of North America Volume 1 "Tsuga heterophylla"

Uses

- Lumber for general construction, as well as pulp for plywood. (Current)
- Bark is a source of tannin for tanning hides. (Historic)
- The needles can also be chewed or made into tea for an elixir rich in Vitamin C. (Current)
- Contains an edible cambium (the spongy cork interior of the bark). (Historic)

Sources: "Manual of Oregon Trees and Shrubs" (Page 72) and "Oregon Forest Resources Institute" (Web)

Citations for images:

http://2.bp.blogspot.com/-AaqRR7Svzh4/Tgid7uYV1gI/AAAAAAAABNE/s1600/Tsuga%2Bheterophylla.jpg (Far Left)
http://www.discoverlife.org/IM/I_SB/0406/mx/Tsuga_heterophylla,_leaf_-_showing_orientation_on_twig,I_SB40690.jpg (Middle left)
http://www.kalesnikoff.com/wp-content/uploads/2013/12/album-hemlock-6.jpg (Middle right)
http://islandnature.ca/wp-content/uploads/2011/12/western_hemlock2.jpg (Far Right)

Western Red Cedar ***Thuja plicata***


Morphology

- Large trees 150’ - 200’ high, and 3’-10’ in diameter, with open pyramidal crown of pendulous, frond-like lateral branchlets.
- Leaves are scale like, in opposite pairs, in four rows, folded in one pair but not in the other and overlapping like shingles. Arranged on the twigs in flat, fan-like sprays.
- Cones about ½” long, erect, ovoid-cylindrical, with a thin reflexed spin near apex.
- Bark is semi-thick, but is very fibrous and peeled off into long narrow strips.

Sources: “Manual of Oregon Tree and Shrubs” (Page 89)

Habitat

- Western Red Cedar grows along the Pacific coast from Humboldt County, CA, to the northern and western shores of Sumner Strait in Alaska.
- Although most commonly found in lush forests and moist habitats, it also can grow on dry or rocky slopes. Rarely found in pure stands, this evergreen thrives in mixed conifer forests, and is frequently associated with Douglas-fir and Western Hemlock.
- It is tolerant of shade and long-lived, sometimes over 1,000 years.

Sources: Forest service silvics of North America Volume 1 “Thuja plicata”

Uses

- The wood of Western Red Cedar is primarily used in roofing for shingles and shakes, because of its attractive appearance, durability, lightness, and superior insulation qualities. It is also used in exterior finishing, utility poles, fence posts, piling, paper pulp, and various containers.
- Cedar leaf oil is often the basis for production of perfumes, insecticides, medicinal preparations, veterinary soaps, shoe polishes, and deodorants.
- Due to its resistance to decay and insect damage, the wood of large, fallen trees remains sound for over 100 years. Even after 100 years, the wood can be salvaged and cut into shakes for roofs.

Sources: “Manual of Oregon Trees and Shrubs” (Page 89) and “Tree Book” (BBC.gov)

Citations for images:
http://fwp.mt.gov/mtoutdoors/images/Portraits/2014/Cedar.jpg (Far Left)
http://science.halleyhosting.com/nature/gorge/tree/conifer/thuja/thujaplicata1.jpg (Mid left)
https://store.speedtree.com/site-assets/uploads/2013/11/Thumb_WesternRedCedar_High.jpg(Mid right)
http://www.ocfp.com/sites/default/files/cedar-siding-altis-home-exterior-design-900x600_0.jpg (Right)

Sword Fern ***Polystichum munitum***

Morphology

- ➢ The sword fern is actually not a shrub, because they reproduce via spores instead of seeds. Much older in evolutionary history, more similar to mosses.
- ➢ The fronds can reach lengths of 1-6 feet, and grow out radially from one central crown.
- ➢ The bottom side of the fronds have visible spore cases that appear as dots, which may appear green to a reddish orange and are released in late summer.
- ➢ Each frond, which can be several feet long, contains as many as 75 to 100 leaves

Sources: "California Academy of Sciences" (Web)

Habitat

- ➢ Sword Fern is a dominant understory plant found throughout the forests of western Oregon. They prefer the understory of coniferous forests at low to mid elevations and grows best in a well-drained acidic soil commonly associated with forest floors.
- ➢ Sword Ferns are very hardy and can survive occasional dry periods, but prefer consistent moisture, light sunlight, and cool weather.
- ➢ The fossil record of fern-like plants starts almost 400 million years ago, and they are still with us today.

Sources: "Ferns and fern allies" (Grillios 1996)

Uses

- ➢ Native Americans used parts of the fern for a variety of medicinal uses such as hastening childbirth, treating dandruff and soothing sore throats.
- ➢ Is sometimes called the "Christmas fern" for the large number of fronds used each year in the making of holiday wreaths.
- ➢ Very strong frond stems which have been used as rope for straps and tie downs.

Sources: "Ferns and fern allies" (Grillios 1996)

Citations for images:
https://www.eskimo.com/~enumclaw/Tips/Pocket%20Gardens/Resources/sword%20fern.gif: left
http://www.teacherwebshelf.com/boekhout/naturesclassroom/bcplants/plantbook02/photos/swordfernclose2.jpg (Middle)
http://2.bp.blogspot.com/-6n7UOcvoJA0/UNzaPM1wXhI/IoJW-UbhlkE/s320/swordImage+6.jpg (Right)

Oregon grape ***Berberis aquifolium***




Morphology

- Oregon grape is a bushy, flowering evergreen shrub with shiny, holly-like leaves.
- Aquifolium can grow up to 3'-10' tall, compared to "dwarf Oregon-grape" which is seldom over 30" high. It is the state flower of Oregon!
- Leaves of 6-12 inches long, alternate, pinnately compound with 5-9 leaflets. Leaf margins spinose (Pointy), dark glossy green above and paler below.

Sources: "Manual of Oregon Trees and Shrubs" (page 154)

Habitat

- Oregon grape is one of our most abundant (and therefore overlooked and underappreciated) native shrubs.
- Used to treat infectious conditions of both the stomach and intestines. Another benefit of its root is its' antimicrobial effect. Oregon grape can easily withstand the dry shade under large trees, though also tolerant of moist conditions. It can grow in full sun, but will suffer if not given some shade where summers are hot, even with more regular water.
- If given space, the shrub will grow quite large and provide yellow flowers and berries.

Sources: "Manual of Oregon Trees and Shrubs" (page 154)

Uses

- The most notable attribute of this plant is its amazing health benefit for humans. Oregon grape root is renowned among herbalists for its ability to stimulate liver function, improve the flow of bile, for blood cleansing, and generally immune booster. Often made into liquid tincture.
- Uses have traditionally included treating both liver congestion and infectious conditions
- Nurserymen and florists use the foliage for greenery in their arrangements.

Sources: "Henriette's Herbal" (Web)

Citations for images:
http://ofearthandair.com/wp-content/uploads/2013/08/oregon-grape.jpg (Far left)
http://portlandnursery.com/plants/images/mahonia/Mahonia_aquifolium500.jpg (Middle left)
http://www.arthurleej.com/images/og.jpg (Middle right)
http://www.nwplants.com/images/shrubs/ber_aqu_jen_7small.jpg (Far right)

Pacific Yew ***Taxus brevifolia***



Morphology

- Pacific Yew is a small to medium-sized evergreen tree, 30'-50' tall, and 1'-2' in diameter.
- A dark green crown of pendulous branches at the top, and the base is frequently asymmetrical and fluted.
- Leaves are ½" - 1" long, linear, awl shaped, dark green above and paler beneath but without white bands; apex pointed, spirally arranged but commonly appears two ranked.
- Bark is thin, dark purple or red-brown; scaly; shiny red on inner bark. Peels off.

Sources: "Manual of Oregon Trees and Shrubs" (Page 105)

Habitat

- Like the Western Hemlock, Pacific Yew tolerates shade, and in undisturbed stands is usually found as an understory tree.
- Prefers moist, well-drained sites.
- The tree is extremely slow growing and has a habit of forming very interesting shapes, maneuvering around the close trees around it. Usually does not grow straight up due to restricting surroundings.

Sources: "Manual of Oregon Trees and Shrubs" (Page 105)

Uses

- The bark of Pacific Yew contains a drug, taxol, which is being used in cancer research, so demand for yew bark by the National Cancer Institute has increased dramatically in recent years.
- The wood is very durable and hard, and requires no preservative treatment even when in contact with soil.
- Makes really good archery bows.

Sources: Forest service silvics of North America volume 1 "Taxus brevifolia"

Citation of images: http://3.bp.blogspot.com/-nshnaFLJhkA/Tvgm5N5FNZI/AAAAAAAAAOM/zsCI8WcZITs/s1600/P1090334+Taxus+brevifolia+Galiano+Island.JPG (Left)
http://2.bp.blogspot.com/-ZrtH46dEalw/AAAAAQCQ/lQRWyfcPeOA/s1600/YewTwigs.jpg (Middle)
http://www.rinr.fsu.edu/fall2002/images/yews.jpg (Right)

Salal ***Gaultheria shallon***



Morphology

- ➢ This evergreen shrub can grow to 5’ in height and spread to 5’ in the shade. In sunny spots the plants may only get 1’-3’ tall.
- ➢ Leaves are simple, alternate, persistent, ovate to oval and 2 to 4 inches long. They have a leathery texture and are dark glossy green above and paler below.
- ➢ Leaf margins are finely serrated along their edges.

Sources: “Manual of Oregon trees and shrubs” (Page 236)

Habitat

- ➢ Salal is most common in Douglas-fir forests of the Pacific Northwest, as a thick groundcover that acts as a secondary canopy for soil anthropoids and insects.
- ➢ Salal is extremely adaptable, thriving in sun, shade, humus, infertile, dry or moist soils. It requires little care once established.

Sources: “WSU Pacific Northwest plants” (Web)

Uses

- ➢ Its dark green, lustrous leaves are popular among commercial florists who use them to create beautiful arrangements.
- ➢ Its berries are edible and have been used for centuries to make jams, and cakes and other delicious foods.
- ➢ Rolling the leaf into a cone produces a tiny natural drinking cup!

Sources: Manual of Oregon Trees and Shrubs” (Page 236)

Citations for images:
http://www.goodfoodworld.com/wp-content/uploads/2013/01/SalalDSC_0035_Medium.jpg (Left)
https://shanesoutdoorfun.files.wordpress.com/2013/07/salal-berry-and-leaves.jpg (Middle)
http://www.ronaldjonesferneries.com/salal.png (Right)

Activity Description

Step 1: *Introductions* *Time: 5 min*

- ➢ Walk to Discovery Trail river wash
- ➢ Introduce yourself to the group.
- ➢ Ask group to circle around and ask

- Q: Does anybody have a favorite tree or plant species? Or perhaps one that has been important in your life?
- Q: What about animal species?
- Q: What do you like about ___ species? (If there's time to kill)
- Q: Who can name a plant species that lives in this old growth forest ecosystem?
- Q: Who can name a tree species that we will see today?

➢ Explain to the students that in order to learn how to recognize and identify the plants we find in these woods, we must first use all of our senses by making careful observations and taking notes just as scientists do in the field. We will be looking at the physical differences between various trees and shrubs down the Discovery trail and jotting down some of the characteristics that set them apart.

Step 2: *Biodiversity Ties Us Together* *Time: 20 min*

➢ Assemble in a circle in creek-bed along Discovery Trail.

➢ Initiate discussion on biodiversity and its importance by asking:

- Q: Can anyone give me a definition of biodiversity?
- A: Biodiversity: the existence of many different kinds of plants and animals in an environment. Just as you all have a diversity of haircuts, or clothing, the forest has a diversity of biological organisms.
- Q: Why is biodiversity important in a forest?
- A: Everything is connected! It is an essential component of nature and it ensures the survival of all species by providing food, fuel, shelter, medicines and other resources to each other, creating massively interconnected network life. Ecosystem productivity is increased in biodiverse areas because each species plays a particular role.

➢ Introduce game by saying “We are going to play a little game that might help us understand these connections better”.

- Using the provided species cards with yard attached, hang a card over each student’s head with the card facing out, on their back
- If there are enough species cards, facilitator should be sun.
- Explain that each student must pair up with someone and question each other to figure out what their species is. Questions could include:
  - Am I a plant or an animal?
  - Do I live close to the ground or up higher?
  - What do I eat?
  - What color am I?

- ➢ Encourage students to talk to other students about their species if they have discovered what their card is.
- ➢ After four minutes, gather students in a circle.
- ➢ Pull out ball of yarn and explain that you are the sun and you will be passing the yarn to a species that you have a connection to. The object of this game is to make the most connections we can, without excluding any species. Some may have more connections than others. (Example, facilitator tosses yarn to Hemlock tree and says, I provide sunlight. Hemlock tree tosses yarn to Pacific Yew and says I grow above you and provide shade. The Pacific Yew passes the yarn to the Pacific Wren that uses its needles to build nests etc...)
- ➢ Keep the yarn tight, but not overly tight
- ➢ At this point, ask the students what would happen if you (the sun) were not a part of this web. The answers might include that it will be dark, or plants would die.
- ➢ Next, ask one of students to tug on the yarn to signify their leaving of the web. Instruct the remaining students to call out their species when they feel the tug to show that they are affected by the leaving of the species. (Example: Hemlock tree removal would affect flying squirrel, pacific yew, Pacific Wren etc.)
- ➢ Count how many species are affected by one leaving.
- ➢ Now return to the question of Biodiversity, ask the students once more why it is important for a forest to have a large diversity of plant and animals?
- ➢ Possible answers to discuss:
    - ○ Biodiversity allows us to live healthy and happy lives. It provides us with an array of foods and materials and it contributes to the economy. Without a diversity of pollinators, plants, and soils, our supermarkets would have a lot less produce.
    - ○ Most medical discoveries to cure diseases and lengthen life spans were made because of research into plant and animal biology and genetics. Every time a species goes extinct or genetic diversity is lost, we will never know whether research would have given us a new vaccine or drug.
    - ○ Biodiversity is an important part of ecological services that make life livable on Earth. They include everything from cleaning water and absorbing chemicals, which wetlands do, to providing oxygen for us to breathe—one of the many things that plants do for people.
    - ○ Biodiversity allows for ecosystems to adjust to disturbances like extreme fires and floods. If a reptile species goes extinct, a forest with 20 other reptiles is likely to adapt better than another forest with only one reptile.
- ➢ Finish by wrapping yard back up and collecting species cards.

Step 3: *Swords and Shrubs* *Time: 10 min*

In this activity students will be guided through plant identification and will utilize observation in order to identify key characteristics of each plant. After finishing biodiversity game, you will hike along the Discovery Trail stopping at each of the following plants to facilitate this activity. Begin with Sword Fern.

1st Plant: Sword Fern

- ➢ Hike from the creek bed to nearby Sword Fern.
- ➢ Q: Does anyone know what this is (pointing at Sword Fern)?
    - If the plant cannot be identified, provide the name to students.
- ➢ Ask students to list name and three characteristics of the species in their field notebooks. (Ex. fronds, low to ground, grows from a central crown, spores on underside)
- ➢ Encourage students to look closely and the top and bottom of plant, noting characteristics that make it unique.
- ➢ Once students are finished writing observations, persuade them to share their findings with the rest of the group.
- ➢ Q: Ask students if they can think of (or already know) a way in which humans could make use of this plant. If they do not know historical uses, Use this demonstration to provide a hint.
    - Hint: For Sword Fern, kneel down and grab one frond, pull your hands away from each other as though it was rope and make sure not to actually break it.
    - Use: Do this to show the strength and that it was once used to secure things and tie things down.
        - There are also accounts of Native Americans cooking the rhizomes to cure diarrhea and rubbing them on one's skin to relieve the itch and burn of nettle stings.

2nd Plant: Oregon grape

- ➢ Continue down the trail a short distance until you reach an accessible example of Oregon grape.
- ➢ Q: Can anyone tell me what this plant is?
    - If not, tell them.
- ➢ Have students list name and three characteristics of Oregon grape in their field journals (Ex. low to the ground, leaves are point around edges, opposite leaves, waxy etc.)
- ➢ Q: Does anyone know how Oregon grape is used by humans?
    - Hint: Ask "Has anyone ever seen a tiny bottle titled Oregon grape in their medicine cabinet?"

- Use: It is a widely used and highly effective herbal medicine! If students are curious, tell them about the various ailments and illnesses the plant can help with. The root extract of the Oregon Grape has been used to:
  - stimulate liver function
  - improve the flow of bile
  - cleanse blood
  - boost the immune system
  - treat infectious conditions
  - soothe sore throats by the Swinomish tribes of Washington

3rd Plant: Salal

- ➢ Continue on trail until you reach a Salal plant
- ➢ Q: Ok this is the last one. Does anyone know the name of this plant?
- ➢ Instruct students to list name and three unique characteristics they observe for salal. (Ex. Leathery texture, dark glossy green leaves, leaves are alternate, dark blue berries).
- ➢ Q: How might this plant be used by humans?
  - Hint: Ask students if they have ever seen this inside their home? If not, explain its use in floral bouquets as the dark, waxy green plant. People go out and collect it mostly for that purpose.
    - Another fun use you can demonstrate is to roll up one of the leaves into a tiny drinking cup.
  - Q: Does anyone think a part of this plant is edible?
  - A: The berries are, they have been used to make jams and cakes, though eating the berries on their own is not as common.
- ➢ Ask the group to hypothesize about why these plants may be located where they are (referring to the forest floor). Some hypotheses may include: abundance of water, shade tolerance and canopy protection.

Step 4: *To the trees!* *Time: 5 mins*

- ➢ After the Biodiversity game, lead the students along the path to the designated circle of trees near the river. Stop slightly uphill from the circle of trees.
- ➢ Invite students to share any differences they can see between the trees from a distance. Some observations may include moss covering, height, leaves or needles, etc.
- ➢ Point out a Big-Leaf Maple, ask the students how this tree is different from the others in the area. Ask students how they might identify this tree on their own (large leaf size).
  - Q: What reason do you think a tree would want to develop large broad leaves?
  - A: To capture sunlight

Step 5: *The Key to the Forest* *Time: 30 min*

- ➢ Walk down the path to the circle of trees. Gather students in a circle.

- ➢ Take a moment to appreciate the surroundings and let the students take it in.
- ➢ Begin by asking students: Does anyone know what a dichotomous key is?
- ➢ Introduce students to a dichotomous key giving its definition (found in **Background Information**).
- ➢ Pass out laminated keys to each student.
- ➢ Explain that we are going to identify three trees and one shrub as a group.
- ➢ Direct students to flip the key around and look at the descriptive pictures on the back.
- ➢ Explain that this will show the difference between scale like leaves and needles, as well as what a lobed leaf and frond look like.
- ➢ Briefly explain how to use the key.
    - Instructions include:
        - If it is a tree, go to step 2.
        - If leaves are needle-like, go to step 3.
- ➢ Start the activity as a group (you can start with the Pacific yew). Guide the students through the keying of one tree before allowing them to key out other species.
- ➢ Double check to see if everyone understands how the key works (if not, explain further).
- ➢ When everyone if finished identifying the tree, ask: "Does anyone know how this tree might be used by humans?"
- ➢ If someone answers that the Pacific yew is used as timber, explain that it actually is not a large enough or straight enough tree to be considered an economically viable timber species.
- ➢ Inform students that this tree has a very special medicinal property that is of high value today. The bark of Pacific yew contains a drug, Taxol, which is being used in cancer research, so demand for yew bark by the National Cancer Institute has increased dramatically in recent years. The wood also makes very good bows, because of its strength and flexibility.
- ➢ Have students key out the Douglas-fir, western red cedar, and western hemlock. Explore the various ways these species have been used by humans (see **Background Information**).
- ➢ If there is enough time, have students key out one of the nearby shrubs (Salal, Sword Fern, or Oregon grape).
- ➢ Collect laminated keys and branches/cones and place them back at base of Douglas-fir tree.
- ➢ If you are the last facilitator at this station, collect materials at end of day.

Step 7: *Emerging Again:* 5 min

- ➢ Exit this station by following the path up towards the road and pump house.
- ➢ The group will then pause to reflect on what they learned and take a deep breath. Provide a quiet moment here.
- ➢ Q: What did you all think about this keying exercise? Pretty simple right?

- ➢ Q: Do you all feel like you will be able identify any of these trees next time you encounter them?
- ➢ Q: Can you imagine how long it would take to compile the descriptions for all trees in Oregon and make them into key?
- ➢ Explain that there are much more complex plant identifying keys out there. Show them the copy of Oregon's Manual for Tree Shrubs.
- ➢ Facilitator can then ask the students while walking how many species they can remember from the day, or test them on naming plants that were covered in the lesson!

Additional Readings/Resources:

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http://www.dfw.state.or.us/conservationstrategy/docs/Beaver_factsheet.pdf

http://www.nwplants.com/business/catalog/ace_mac.html

http://www.encyclopedia.com/topic/Usnea.aspx

Closing Ceremony
Wrap-up and Reflect

The whole class will regroup at the pavilion and have a discussion, closing activity, and departure from H.J. Andrews.

Time: 15 Minutes

Step 1: *Regroup at the pavilion* *Time: 5 min*

- ➢ Once you arrive at the pavilion, have your team put their hard hats in the correct, color-coded mesh bag.
- ➢ Instruct students to grab their journals and then join you out in the field (or in a circle under the pavilion if raining).

Step 2: *Evaluation and Reflection: Field Journal* *Time: 5 min*

- ➢ Instruct students to use their completed field journals to answer questions for the evaluation worksheet (**See Appendix H**). Questions are based off of the learning objectives described by each station and are already included in the field journals (**see Appendix A**).
- ➢ Students will fill out and complete their journals and will be able to take them home. When the students are finished, they will return their completed worksheet and receive a sticker (**see Appendix B**).

Step 3: *Group Discussion and Grounding* Time: 5 min

- ➢ After everyone has dropped off their equipment and gathered in a big circle, start off with some simple and fun questions to bring everyone in on the on the same page.
    - ○ Share a word or phrase about the day.
    - ○ What was the most interesting thing you learned today?
    - ○ What was one thing you experienced that you did not expect?

Step 4: *Gratitude* Time: 2 min

- ➢ Thank students for their participation.
- ➢ Take one last intentional moment of gratitude: Ask students to close their eyes and silently think of a moment in their day that inspired them, made them feel happy, or any moment that they appreciated.
- ➢ After 10 seconds of silence ask students to join you in a loud thank you for PTCI and H.J. Andrews for inviting us to spend our time with them.
- ➢ Say final farewells and instruct students to join their teachers on the bus.

Appendix A
Matching Game Terms

Species Composition

The different species represented in a biological community

Species Abundance

The number of members of a species existing in a specific location

Evergreen

A plant that retains green leaves throughout the year

Temperate

A region or climate characterized by mild temperatures

Decomposition

The state or process of rotting; decay

Microclimate

The climate of a very small or restricted area, especially when it is different from the surrounding areas

Ecosystem

A biological community of interacting organisms and their physical environment

Succession

Predictable and orderly changes in the composition or structure of an ecological
community

Biodiversity

Variation in life; can be genetic or within
species or ecosystems

Conifer

A tree where seeds are produced inside of cones

Disturbance

An event that occurs quickly and creates a
significant change in an ecosystem

Old Growth

The final, most stable stage of a forest ecosystem

Forest Floor

The lowest layer in a mature forest; consists of
decaying plant matter and decomposers

Understory

The middle layer in a mature forest; consists of plant life that does not breach the upper layer of the forest

Canopy

The top layer of mature forests; consists of
tree crowns and the organisms that live there

Photosynthesis

The process by which green plants and some
other organisms use sunlight to synthesize foods
from carbon dioxide and water

Appendix B
Field Journal

Each student will receive a small journal with approximately 10 pages to use to make observations throughout the day. Students will be able to use information collected in the journal for the worksheet at the end of the day and will also be able to take them home after the trip.

Questions you will ask during the day to prompt journal usage:
Station One: The Tree Climb

1) List the three layers of the forest.

Station Two: Karin Rita Gastreich's Studio

1) What do a scientist and an author have in common?

Section Three: Life after Death

1) List the 3 layers in the cross section of a tree

Station Four: Naming and Knowing

1) List 3 tree species that live in the H.J. Andrews forest.
2) (students will also be writing down plant characteristics during this station)

Appendix C
Sticker

Appendix D
Gastreich's Forest Story

(Revised from Karin Rita Gastreich's Journal):

"I am hiking through the beautiful forest of the Cascade Range and I realize that whether I enter the forest as a biologist or as an author, the challenge remains the same. I wonder, how can I capture this world and communicate its magnificence to others? I was asked to study the forest from a writer's perspective from HJA, and I've found that my approach to studying the forest as an author is the same as a biologist:

I stop. And then I 'listen.' With all my senses.

And I write.

A poem.
She pressed her hands against the rough bark,
closed her eyes and heard the pulse of the tree,
solid and slow, a steady current that stretched
toward the sky and descended into the deepest
places of the earth, a quiet murmur of
indomitable strength.

I think to myself, it is not an easy task to listen, and it is also hard to listen to creatures who speak in a different language. But when I 'listen' to the forest, I notice the way the moss hangs from the branches or covers the logs.
The chill of the air.
The shape of the fungi.
The flow of the river.
The hushed sway of the canopy in the breeze.
The rhythmic chirp of a small bird,
and the 'plasticky crunkle,' of my rain coat as I write my observations.
'Plasticky crunkle,' neither word can be found in the dictionary, but it is what I hear, so I write it down.
I hear the 'swoosh' of the trees, and the 'peckling' of a Pileated Woodpecker in the tree across the forest, so I write it down.
I write sounds for what I hear, I draw what I see, and I write words for what I feel.

Appendix E
Stages of Decomposition

Stage 1: No moss, bark is still present, wood is clear may have slight blue tint.

Stage 2: An increase in decay, bark becomes damaged; heartwood stays healthy, sapwood begins to decay.

Stage 3: Log itself begins to decay into bark and stubbed branches, wood becomes damaged.

Stage 4: Almost all bark is no longer visible, can no longer support own weight, sapwood is no longer present and heartwood begins to crumble

Stage 5: Log no longer exists in the log shape, begins to turn into a powder where you can see the outline of the decaying matter.

Appendix F
Two Truths and a Lie Cards

Fungi

Hint: Live in all different types of habitats and grow where there is decaying organic matter to be consumed.

1) There are many species of my kind, I can be autotrophic and heterotrophic depending on the type of fungus I am.
2) My favorite spot to live is along/on trees.
3) I do not contribute to the decomposition process.

Banana Slug

Hint: Prefer lowland areas of high moisture/plant decay. Live on consuming plant material, mushrooms, animal feces, etc.

1) I am autotrophic.
2) I have thin skin and I produce a mucus to help me keep cool
3) I am sensitive to dry climates, as they affect the moisture content of my skin

Earthworm

Hint: I live in soils of high moisture content, where I burrow deep beneath the soils eating plant matter, castings, or decaying animals.

1) I am heterotrophic.
2) I can live in dry soils, without causing too much harm to my body
3) I help in breaking down organic matter that increases nutrient content in soils

Woodlouse

Hint: You can find me within a pile of leaves or in dead bark, I am usually found in areas of high moisture. I am considered a crustacean.

1) I am an insect.
2) I am heterotrophic
3) I play a role in the natural carbon cycle due to my ability to consume dead organic matter.

Moss

Hint: I grow in clumps, and will never have the opportunity to flower. I spend most of my time in moist habitats that provide significant amounts of shade, however I can grow in dry climates as well.

1) I am considered autotrophic.
2) I feed off of organic matter from nearby soils
3) There are many different species of my type.

Douglas fir

Hint: I am a tree whose sapling can grow from a dead tree. I am considered Oregon's state tree, and keep my green throughout the year. I can be found in coastal climates as well as rocky slopes, as long as I prefer soils that can drain fast but provide moisture as well.

1) I help the decomposition process by absorbing nutrients from organic matter
2) I am autotrophic.
3) You can find me in areas with other Douglas fir trees

Appendix G
Species Cards

https://bioweb.uwlax.edu/bio203/f2013/lacoursi_nath/15480405.jpg

Relies on: Western Hemlock, Douglas Fir, Big Leaf Maple, Pacific Yew

Rough Skinned Newt

Taricha granulosa

- Brownish on top, yellow on bottom
- Amphibian
- Has toxin on skin
- Lives in moist coastal forests
- Finds shelter in or under soft logs

http://birdnote.org/show/what-pacific-wren-hears (Gregg Thompson)

Relies on: Sun, Pacific Yew, Big-Leaf Maple, Douglas-Fir, Western Hemlock

Pacific Wren

Troglodytes pacificus

- Small bird that thrives in moist coniferous forests
- Builds nest within six feet of ground
- Eats insects and seeds/berries

http://yournec.org/sites/default/files/images/flying%20squirrel.img_assist_custom-374x226.jpg

Northern Flying Squirrel

Glaucomys sabrinus

- A small mammal capable of gliding between trees
- Nocturnal by nature
- Omnivore, eats seeds, insects, fungi and eggs
- A favorite food of the Northern Spotted Owl

Relies on: Western Hemlock, Douglas-Fir, Big-Leaf Maple and Pacific Yew
The Northern Spotted Owl relies on me.

http://2.bp.blogspot.com/-AaqRR7Svzh4/Tgid7uYV1gI/AAAAAAAABNE/s1600/Tsuga%2Bheterophylla.jpg

Western Hemlock

Tsuga Heterophylla

- Large coniferous tree that grows 125-200 feet tall
- Trees typically have a slightly droopy top
- Very shade tolerant, grows well under Douglas-fir trees
- Needles are rich in vitamin C and are used by humans and animals

Relies on: sun
Rough skinned newt, Northern Spotted Owl, Pacific Wren, Northern Flying Squirrel and Red-Tree vole rely on me.

http://3.bp.blogspot.com/-nahnaFLJbkA/Tvgm5N5FNZI/AAAAAAAAAOM/zoC1kWcZITa/s1600/P1090334+Taxus+brevifolia+Galiano+Island.JPG (right)

Pacific Yew

Taxus brevifolia

- Small to medium evergreen tree
- Grows very slowly
- Bark is dark purple to red in color
- Frequently grows in odd shapes following sunlight

Relies on: Western Hemlock, Pacific Yew, Douglas-Fir and Big-Leaf Maple
The Red-Tree Vole, Pacific Wren, Rough Skinned Newt and Northern Flying Squirrel rely on me.

Image from Smithsonian Magazine.
(http://media.smithsonianmag.com/images/female-spotted-owl-in-tree-7.jpg)

Northern Spotted Owl

Strix occidentalis caurina

- Spotted owls are listed as threatened and only live in moist old growth forests of the Pacific NW
- Live in canopies and standing snags of trees
- Eats small rodents like flying squirrels and voles

Relies on: Western Hemlock, Douglas-Fir, Big-Leaf Maple, Northern Flying Squirrel and Red Tree Vole

http://www.corvallisadvocate.com/wp-content/uploads/2013/03/glidart_photo.jpg

Relies on: Western Hemlock, Douglas-Fir, Pacific yew
The Northern Spotted Owl relies on me.

Red-Tree Vole

Arborimus longicaudus

- Small rodent, resides in older coniferous forests in W. Oregon and NW California
- Live in tree tops and rarely ventures to forest floor
- Diet consists of conifer needles
- Gather live conifer branches for nests
- One of the favorite foods of the Northern Spotted Owl

http://www.treeseedonline.com/uploads/1/0/2/3/10233208/s468003859194629765_p102_i1_w1440.jpeg

Relies on: Sun
The Red-Tree Vole, Northern Flying Squirrel, Pacific Wren, Rough Skinned Newt and Northern Spotted owl rely on me.

Douglas-fir

Pseudotsuga Menziesii

- Coniferous tree common in western forests
- Can grow up to 250 ft tall in old-growth forests
- Bark varies from gray to brown but is usually deeply furrowed
- The seeds and cones provide food for many small mammals
- Provide shade for many understory species

http://www.nwplants.com/images/commons/Acer_macrophyllum_jko0927100.jpg

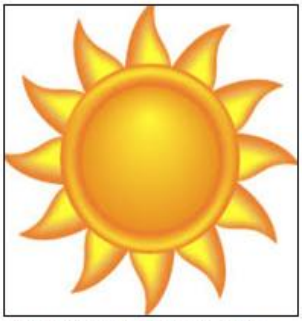
Big-leaf Maple

Acer Macrophyllum

- A deciduous tree that can reach up to 100 feet tall
- Trees tend to host many mosses, lichens and ferns on its branches
- Known for its distinctive large leaves

Relies on: sun

Pacific Yew, Red-Tree Vole and Northern Flying Squirrel rely on me.



http://weknowyourdreamz.com/images/sun/sun-03.jpg

Sun

- Provides light for plants
- Provides warmth for animals

Appendix H
Dichotomous Key

Dichotomous Key to plants in the old growth McKenzie watershed

1a. A tree.....2

2a. Leaves needle like or scale like, evergreen; seeds usually in cones.....3

3a. Leaves are scale like, concealing (completely covering) the twig; bark is reddish brown and creased; seed cones are about 1 cm long; >200 ft tall in maturity.....**western red cedar**

3b. Leaves needle like, not concealing the twig.....4

4a. Needles long and flat, spiral around twig; seeds cones with prominent 3-pronged bracts bark is dark brown, furrowed, thick and fire resistant.....**Douglas-fir**

4b. Needles are shorter in length and wider, do not spiral around trig but lay in a similar direction.....5

5a. Needles two sided, whitish on the underside, flat and blunt; bark is rough, gray to reddish brown in color.....**western hemlock**

5b. Needles of equal lengths, sharp and pointed; bark is reddish brown, papery and scaly, shorter tree, reaches middles of canopy. .....**Pacific yew**

2b. Leaves broad and annually deciduous (not present in the winter); Seeds are enclosed in fruit (not cone).....6

6a. Leaves are large and broad (at least 5" across) with 5 lobes; bark in older trees is gray-brown, ridged, and often covered with mosses, lichens, and ferns.....**big leaf maple**

6b. Leaves are broad (less than 5" across) with usually 7 lobes, fanlike and circular, jagged edges; 20-40 feet tall at maturity.....**vine maple**

1b. Not a tree; understory and ground cover plants.....7

7a. Woody stem present (a shrub).....8

8a. Leaves deciduous, alternate, about 1" long; entire shrub is 2-6 feet tall; pinkish flowers; bluish-black to purple berries.....**Huckleberry**

8b. Leaves evergreen, dark green, thick and leathery.....9

9a. Leaves alternate and finely serrated; stems are thick and hairy, small white and pink flowers (in summer); fruits are dark blue, abundant ground cover.....**Salal**

9b. Leaves opposite, waxy, pointed at the ends, resembles holly; ½ to 2 feet tall; yellow flowers in the summer; fruit is dark blue to purple.....**Oregon grape**

7b. No woody stem present (not a shrub).....**Sword fern**