Trail Stop #1
Forest Opening

Swipe left/right to navigate

Click the large play button in the upper right to begin

Trail Stop #1

How bright is this spot compared to the walk through the forest to get here? *Check the best answer.*

☐ *Very bright*
☐ *Bright*
☐ *Not bright, Not shaded*
☐ *Shaded*
☐ *Very shaded*

This spot where you are standing is an example of a disturbance. *Pick the answer that best defines forest disturbance:*

☐ Zombies hiking through the woods
☐ Events that impact a forest's structure and composition
☐ When a tree falls down and makes a sound
☐ Elk migration through the forest
☐ Climate change

Disturbances are natural or human-caused events that change the structure and/or physical environment of the forest. Disturbances may catalyze changes in species composition and ecosystem processes. While seemingly disruptive in the short term, some disturbances can also contribute to diversity of the ecosystem. In fact, every spot you will visit in this forest has experienced at least one disturbance over the last several hundred years, and these disturbances all impact what you see there today.

What kind of disturbance do you think created this spot?

☐ Fire ☐ Flood ☐ Drought
☐ Storm ☐ Insects ☐ Landslide
☐ Tree disease ☐ Logging

How can you tell? What signs do you see that suggest this was the cause, and what signs would you expect instead if it were another type of disturbance?

_____(short answer)_____

When do you think this disturbance happened?

☐ Last year ☐ 5 years ago ☐ 10 years ago
☐ 25 years ago ☐ 50 years ago ☐ 100 years ago

How can you tell? What led you to this conclusion about the history of this disturbance?

_____(short answer)_____

Notice the plants growing in the treefall gap and on the opposite side of the trail. Which species from the list below do you see in the disturbance zone? Which species do you see in the forest understory? *Check the boxes on your handout to mark where you observe each species*

	Treefall gap	**Forest understory**		**Treefall gap**	**Forest understory**
Trailing Blackberry  	☐	☐	Vine maple  	☐	☐
Western hemlock  	☐	☐	Fireweed  	☐	☐
Pacific rhododendron 	☐	☐	Twinflower  	☐	☐
Red huckleberry  	☐	☐	Pacific trilium  	☐	☐

Which species did you observe thriving in the disturbance zone that you did not notice in the understory, and which species did you observe in the understory but not in the disturbance zone?

_____short answer_____

For species you noticed growing in both locations, what differences did you observe between the individuals in the disturbance zone versus the individuals in the understory?

_____short answer_____

Explain these differences. What are the key ways that resources for plants differ between locations? *Check all that apply*

☐ Access to water ☐ Access to nutrients ☐ Access to Carbon

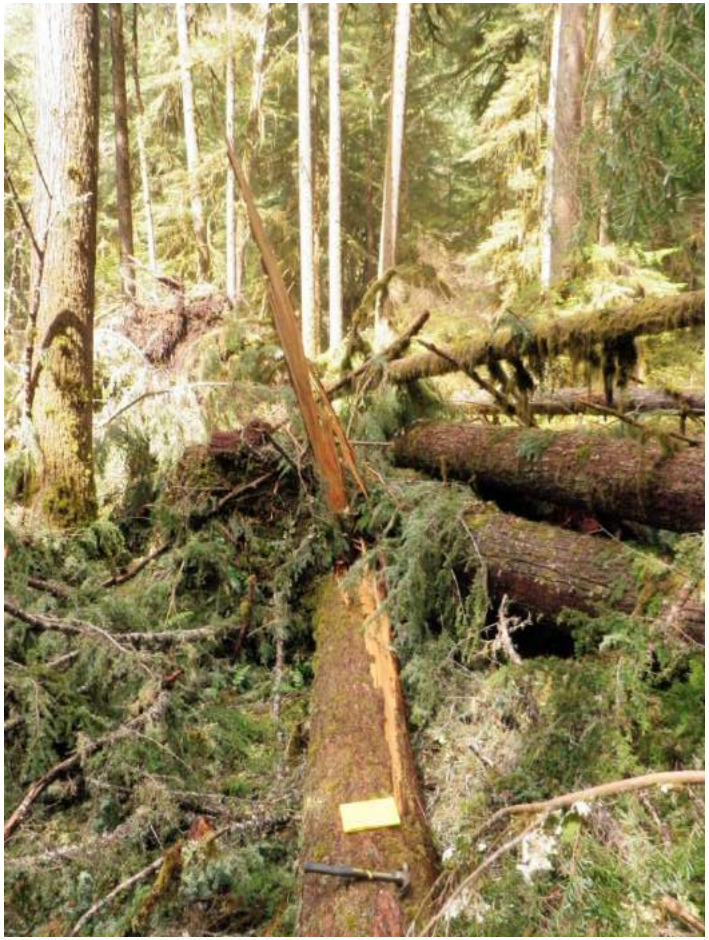
☐ Symbiotic relationships ☐ Available habitat ☐ Access to light

These photos of where you are standing were taken in April 2010, about three months after the blowdown event and a year before the Discovery trail was built.

Compare the plant life in this spot then to what you see in front of you now.

Do you recognize any of the plants you just identified in the newly formed canopy gap in these photos? Which plants survived the gap formation process? How do you think the disturbance affected them?

_____short answer_____



What has changed on the forest floor? _____short answer_____

How has the environment changed for the plants growing there? _____short answer____

Trail Stop #1 Reflection: ***Click here for guided reflection***

Briefly describe your experience. Each person shares 3-5 sentences.

Group Member 1: _____(short answer)_____

Group Member 2: _____(short answer)_____

Group Member 3: _____(short answer)_____

What did you learn from being challenged, or how did the challenge make you stronger, more aware, more resilient, or more uniquely yourself? 3-5 sentences each.

Group Member 1: _____(short answer)_____

Group Member 2: _____(short answer)_____

Group Member 3: _____(short answer)_____

What did your group learn both from sharing your own experience and from hearing about other people's experience of change? 3-5 sentences from the whole group.

Group: _____(short answer)_____

Trail Stop #2
Streambed

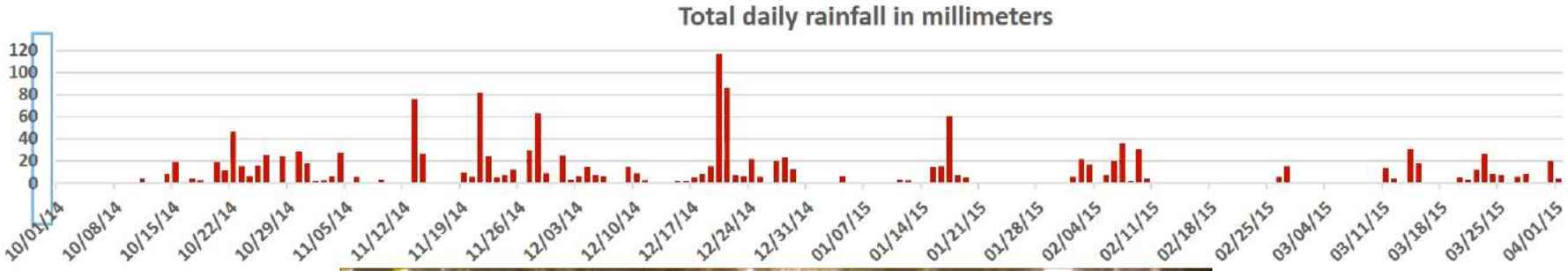
Swipe left/right to navigate

Click the large play button in the upper right to begin

Why do you think there is a stream bed here?

☐ thousands of years ago the climate was wetter and there was a stream flowing here
☐ water flows here sometimes
☐ a big flood scoured out this channel
☐ a landslide caused the stream to change course leaving this dry channel
☐ it is a stream with water flowing in it right now, why would you ask this question?

Click play on the next slide to watch a short video about this streambed


Total daily rainfall in millimeters
120
100
80
60
40
20
0
10/01/14
10/08/14
10/15/14
10/22/14
10/29/14
11/05/14
11/12/14
11/19/14
11/26/14
12/03/14
12/10/14
12/17/14
12/24/14
12/31/14
01/07/15
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01/21/15
01/28/15
02/04/15
02/11/15
02/18/15
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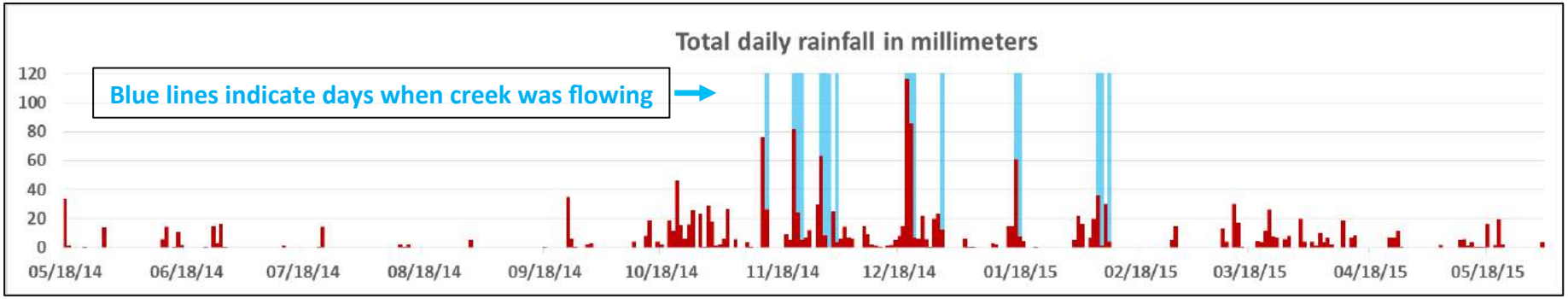
03/25/15
04/01/15


WINGSCAPES
DISCTRSTREAM
01 OCT 2014 10:00 am



What patterns over time do you observe in the video and the graph above about the presence, absence, and quantity of water flowing in this streambed?

_____(short answer)_____

What is the connection between stream flow and rainfall?

_____(short answer)_____

Can you predict whether the stream will be flowing on a given day based on that day's rainfall? Y☐ N☐

How can you predict whether the stream will be flowing based on the rainfall of the previous day, week or month? Use the graph to explain your group's answer.

_____(short answer)_____

What is a watershed? (pick the best answer)

☐ a human-built facility for storing water, e.g. a shed or a tower that holds water
☐ a natural feature that stores water, e.g. a pond
☐ the path of a single river flowing from the mountains to the stream
☐ the cycle of evaporation, condensation, and precipitation
☐ an area of land from which all of the water flows to a common outlet

_____

Where does the water that flows in this streambed during some parts of the year originate?

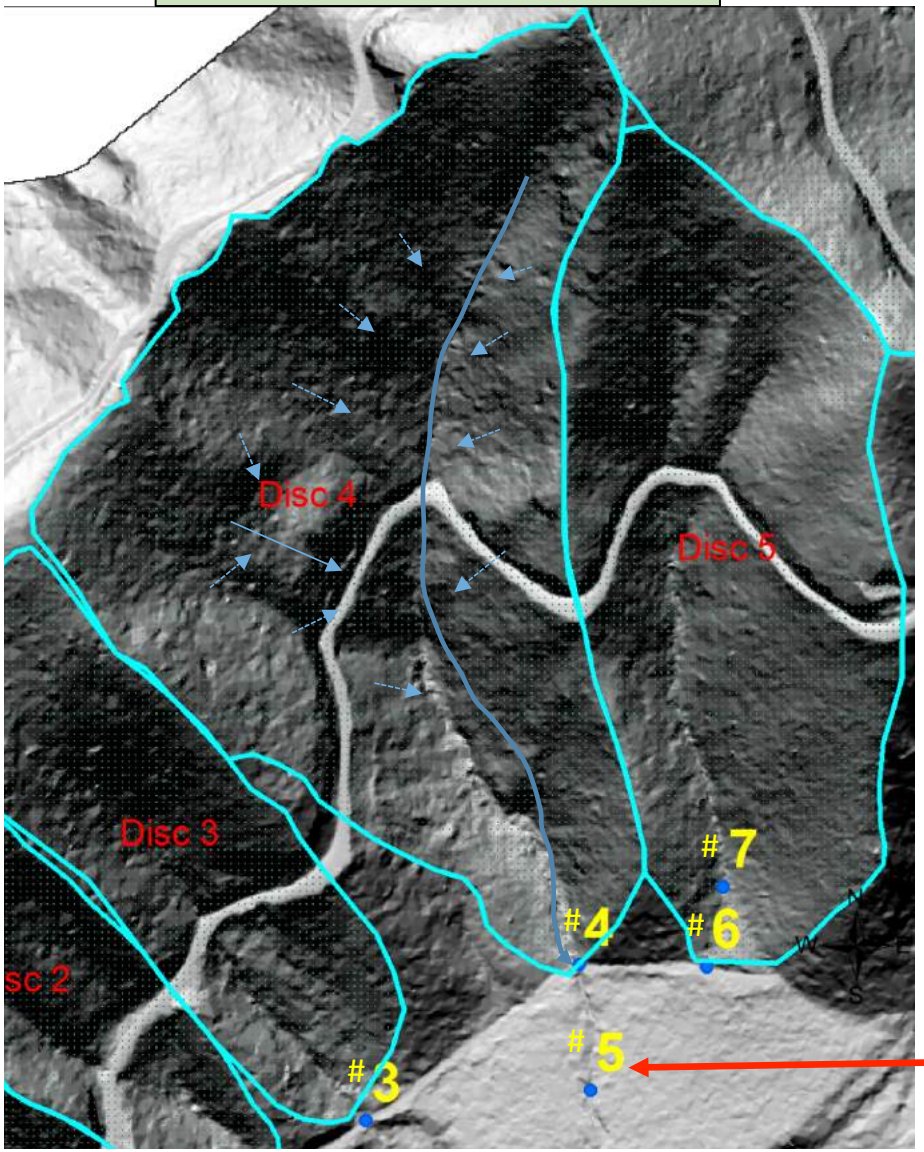
_____(short answer)_____

Where does the water that flows in this streambed go?

_____(short answer)_____

Flip to the next slide to see the watershed you are in

Disc = Discovery Watershed
# - points along the Discovery Trail



Rain that falls on the slope above flows through the soil and eventually into one of the stream channels. Each channel that is visible on this LiDAR image has a watershed that is defined by the topography of the mountain slope and subsurface flow paths, indicated approximately by the turquoise boundaries.

Question to ponder: *Point 4 (marked in yellow) is farther upstream than point 5, but there are days when water is flowing at point 4 and not at point 5. The same is true for points 7 and 6. What could explain this pattern? Keep your eyes out for differences in the physical characteristics of the stream channels and surrounding landscape as you cross the streams on the Discovery trail.*

You are standing at Point 5. Here the stream flows out of watershed Disc 4 and over an old alluvial terrace along Lookout creek.

Close your eyes and listen to excerpts from “Interview with a Watershed” by HJ Andrews writer-in-residence Robin Wall Kimmerer, which she wrote while visiting the forest.

Please record your answers to the following 5 questions:

Why does Kimmerer suggest we should listen to water and to the land?

_____(short answer)_____

How is water a storyteller, and what story is it telling?

_____(short answer)_____

What role does scientific research play in Kimmerer's discussion about interviewing and understanding place? How is it useful, and how is it limiting?

_____(short answer)_____

What story is water, or the absence of water, telling here in this streambed where you are standing?

_____(short answer)_____

What factors in the environment impact the water we see in streams, rivers and lakes? *Check all that apply.*

☐ Sunshine	☐ Topography	☐ Storms	☐ Soil type
☐ Annual rainfall	☐ Home water use	☐ Population density	☐ Ocean evaporation
☐ Pollution	☐ Beavers, other critter activity	☐ Agriculture	☐ Logging

Trail Stop #3
Forest Succession

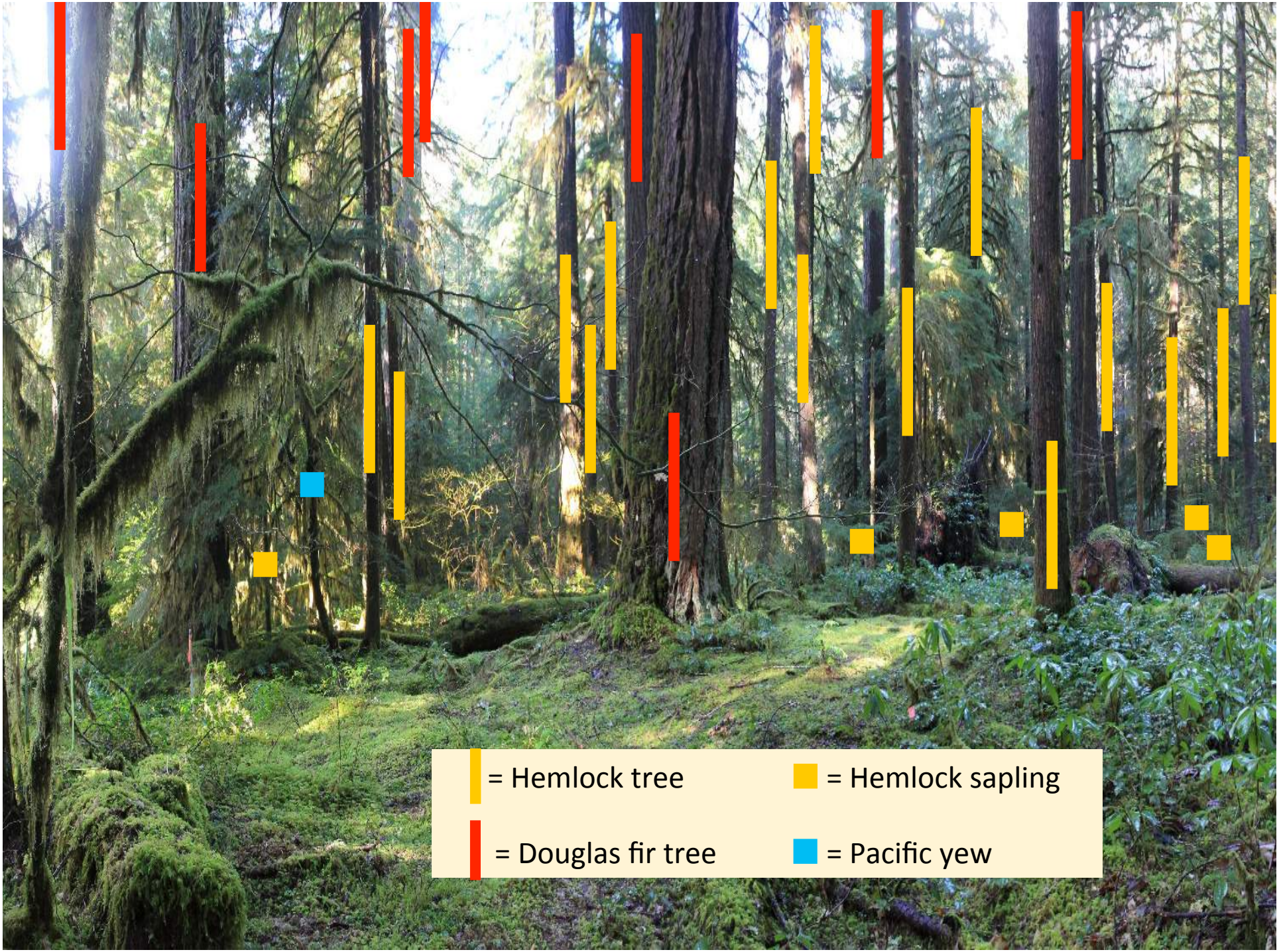
Swipe left/right to navigate

Click the large play button in the upper right to begin

You can learn a lot about a forest and its history through simple observation. Take a few moments to observe the forest around this spot. Pay close attention to the sizes of the trees.

- Are all the trees the same size?
- The same height?
- How many different species do you see?
- Can you observe patterns in how trees of different species are distributed vertically and horizontally in this stand?

If you have trouble identifying the trees you can use the annotated picture from this spot (next slide) to match the trees in the image with the what you see before you (note that some trees in the image are very close and some are as far as 60 yards away). Once you have the hang of it you should be able to identify many other trees around you that aren't in the image.


= Hemlock tree
= Hemlock sapling
= Douglas fir tree
= Pacific yew

What species are the largest trees in this part of the forest?

☐ Hemlock ☐ Pacific yew ☐ Douglas fir ☐ Cedar ☐ Oak

What species of trees are present as saplings in the understory?

☐ Hemlock ☐ Douglas fir ☐ Pacific yew ☐ Cedar ☐ Oak

What physical differences do you see between Douglas fir and western hemlock trees?

☐ Bark texture ☐ Height ☐ Leaf shape ☐Branch density ☐ Girth

Some plant species are able to survive for many years in deep shade while others require a lot of sunlight. You have enough information in the scene in front of you to figure out which, if any, of these tree species *are shade tolerant* and which are *light demanding*.

What species are shade tolerant?

☐ Hemlock ☐ Pacific yew ☐ Douglas fir ☐ Cedar ☐ Oak

What species are light demanding?

☐ Hemlock ☐ Pacific yew ☐ Douglas fir ☐ Cedar ☐ Oak

Based on the tree rings you saw at the kiosk:

How old do you think the Douglas fir trees are in this stand? _____

How old are the hemlocks? _____

How old are the pacific yew? _____

By now you will have deduced that Douglas fir is a light demanding species. In fact, even in the canopy gap disturbance you saw at stop 1 it is highly unlikely that a Douglas fir seedling would survive to become an adult tree (while the western hemlocks and western redcedar in that gap have a great chance of growing up into the canopy). You have also probably figured out that the large trees in this stand must be many hundreds of years old – at least 400, maybe 500.

Try to imagine what this spot looked like 500 years ago, when the Douglas fir trees in the canopy were just starting out as seedlings.

What do you imagine? What was different here? _____

What kind of disturbance might have allowed the Douglas firs to get their start?

☐ Fire	☐ Flood	☐ Drought
☐ Storm	☐ Insects	☐ Landslide
☐ Tree disease	☐ Logging	

You can see that some of the large Douglas firs from the canopy have fallen and died, or died and fallen. If this process continues, which it will since on average one out of every 300 or 400 trees dies each year, what will this stand look like 500 years from now?

_____

In the previous question, you imagined a future version of this forest without a major disturbance, in which individual trees die and create gaps. This scenario would likely result in a forest that is dominated by hemlock and cedar, as these are the shade tolerant species that dominate the understory and lower canopy and can take advantage of small canopy openings to replace the fallen giants.

A more realistic future, though, would likely include a major disturbance, beyond the deaths of individual trees. For example, if there is a big fire in the next 500 years, few of the hemlock will survive, since their thin bark makes fire survival unlikely. Depending on the fire intensity some of the big Douglas firs with thick bark may survive, but a fire would open the canopy enough to facilitate the establishment and growth of light demanding species.

But the fire hypothesis is only one possible future. The impacts of a changing climate or other large-scale disturbances would create instead a very different forest. We can't know the future, but we can imagine different scenarios as we envision the forest over time.

Pick a major disturbance (e.g. fire, flood, storm, insects, landslide, tree disease, logging, climate change) and imagine the forest structure in 500 years. What does the future look like? _____

Disturbances start the process of succession, which is the cyclical process of forest composition change, by altering the physical environment. A windstorm or heavy snowstorm may bring down one or many trees, as you saw at trail stop 1. A disease like laminated root rot may kill a large cluster of Douglas-fir trees. But these are still small-scale disturbances compared with other important disturbances in this region. It took a large disturbance to provide the opportunity for these old growth Douglas fir to make it into the canopy.

We know from tree ring records that the disturbance was fire. Even in this relatively wet forest system, fire is major disturbance, even though a particular area may not experience a fire more often than every 150 or even 500 years. These giant Douglas firs around you are the legacy of the last fire at this site.

Many of the hemlock trees have taken advantage of treefalls and other smaller canopy openings to grow up from the shaded understory into the canopy. The seedlings and saplings around you may or may not survive long enough for an opportunity to allow them to replace the canopy trees above – the next disturbance could release them, or it could kill them.

Fire Narratives and the Power of Story

Forest fires are are neither good nor bad on their own. Their impact depends on context and perspective, which means their impact needs to be qualified by describing good or bad for whom or for what. For example, a forest fire might be good for woodpeckers who take advantage of dead standing trees as sources of insect food, while at the same time bad for a red tree vole or spotted owl whose habitat is altered. A fire might be good for the ecosystem and also bad for humans living near the forest; it might be beneficial in one area and problematic in another area, or beneficial in the long term but problematic in the short term. The same fire might be both good and bad, or beneficial and destructive, depending on what factors you are describing.

But the words we use to describe fire matter, and when our stories portray only part of the story, we limit the ways we understand the role of fire in our landscapes. The stories we tell impact the attitudes people have about fires. If people believe that fire is only a destructive monster, they might feel fear about fires without also understanding the benefits. And embracing the complexity of fire, and all things, is one way to appreciate its beauty.

Brainstorm a list of the ways that forest fires can be HARMFUL, and for WHOM or WHAT:

1. _____
2. _____
3. _____
4. _____
5. _____

Brainstorm a list of the ways that forest fires can be HELPFUL, and for WHOM or WHAT:

1. _____
2. _____
3. _____
4. _____
5. _____

Some benefits of periodic forest fires include:

- Maintenance of species diversity, by creating forest networks at different stages of ecological succession. Just as many species depend on old growth, a number of animal species depend on early successional habitat (younger forests) created by fires, and some of these species have experienced dramatic population declines since a century of fire suppression has reduced available habitat.
- Control of some tree pathogens, which can be inhibited by fire or smoke
- Nutrient input into soils, because fire releases the nutrients in organic matter, making them more available to plants and soil microorganisms
- Reduced probability of catastrophic fire in some drier areas, where a history of fire prevention has resulted denser forests with an abundance of fuel for fires
- Control of some insect pests, both by the direct reduction of adults, larvae, and eggs in a fire, as well as the the indirect reduction of tree susceptibility to insect attack in a less dense forest (particularly in drier forests)

What other words might we use to describe fire other than *destructive*, *monster*, and devastating? As a group, brainstorm a list of words to describe fire that capture some of its benefits or complexity and provide a few words of evidence to support your claim that fires work in these ways.

1. _____
2. _____
3. _____
4. _____
5. _____

Can you think of other things in your life that are also both good and bad, or beneficial and problematic, at the same time? What other things are similarly complex, context-dependent, and a matter of perspective? Brainstorm a list as a group and be sure to describe how each item on your list can be viewed in different ways, and by whom or what.

1. _____
2. _____
3. _____
4. _____
5. _____

Trail Stop #4
Decomposition Field

Swipe left/right to navigate

Click the large play button in the upper right to begin

Listen to Jerry Martien read his poem “Return of the dead log people” at the H.J. Andrews Experimental Forest Long-Term Decomposition Site, a 200-year experiment designed to study the entire decomposition process, from fresh log to new soil.

Type your group responses in the boxes on your handouts:

Who are the dead log people Martien describes?

_____(short answer)_____

Who is the 'you' the author refers to in the poem?

_____(short answer)_____

What is this poem about (*hint*: There is no right answer! As long as you use evidence to support your point, there can be lots of correct responses)?

_____(short answer)_____

How does this poem help you better understand the H.J Andrews Forest and the decomposition process? How can poetry help us understand or connect to place differently than science, informative tours, or personal experience?

_____(short answer)_____

Compared to Trail Stop #1, this disturbance site is: (*check the one that applies*)

☐ Older ☐ Newer

Explain the evidence you used to come to this conclusion.

_____short answer_____

Examine the downed logs around you. What do you notice about them that is different from the logs at stop 1?

_____short answer_____

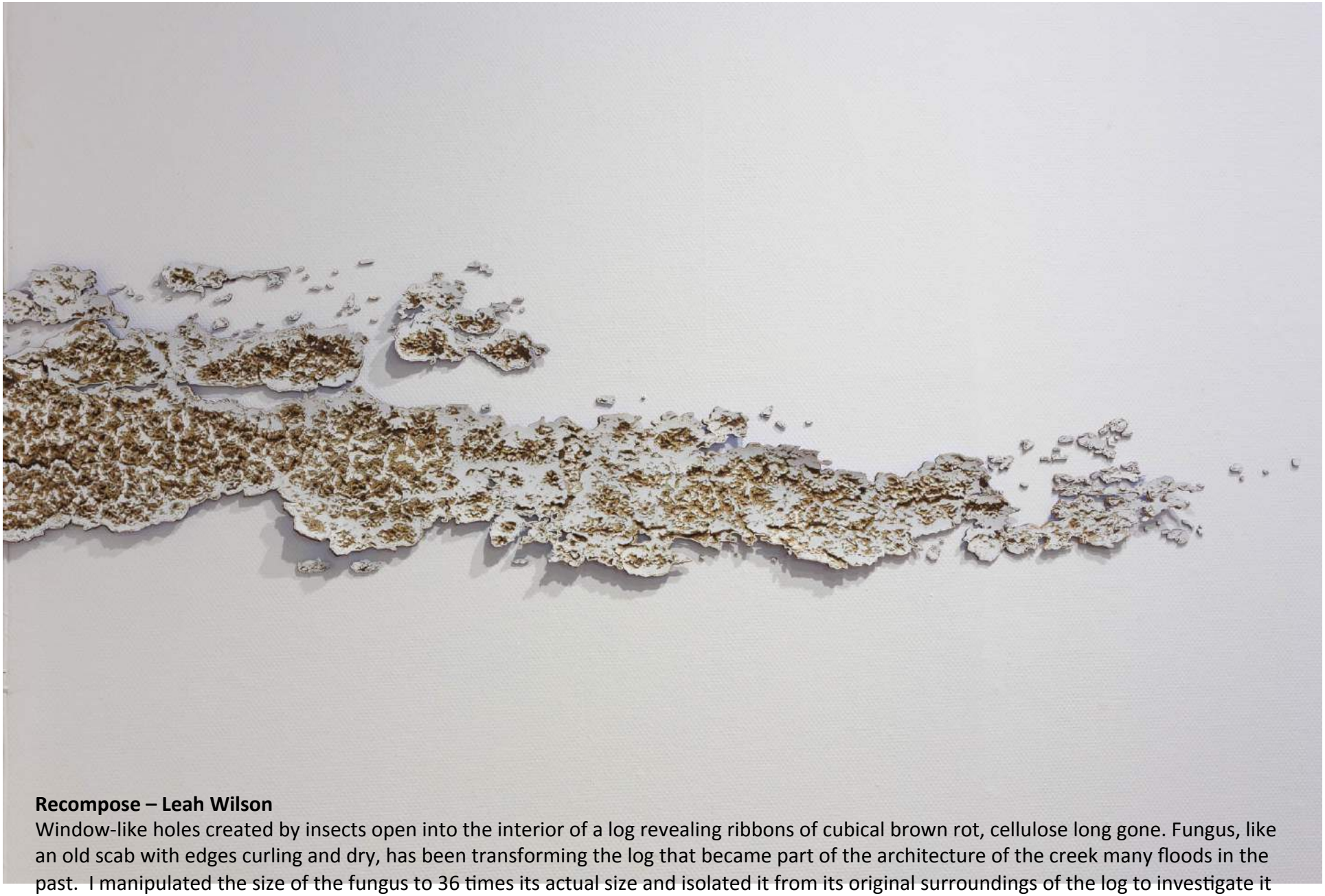
What role do logs play in the forest ecosystem? (click all that apply)

☐ Impede growth of plants
☐ Store and release water and nutrients
☐ Small mammal travel corridors
☐ Nurseries for young plants ☐ ☐
☐ Artistic inspiration
☐ Amphibian habitat
☐ Hazard for forest wildlife
☐ Nitrogen fixation
☐ Diversity hotspots
☐ Chemostasis

Listen to forest ecologist Mark Harmon describe the world of the decomposing log

Scientists aren't the only researchers who study decomposers in detail. H.J. Andrews Forest artists Leah Wilson, creates place-based paintings that address changes within environmental ecosystems over time. Both her artistic process and her finished paintings reflect an engagement with ecology and environmental engineering through observation and data. In addition to drawing attention to natural cyclical changes, many of her paintings tell stories of landscapes that have been exploited and manipulated for their natural resources, and reveal the results of ongoing habitat restoration projects. In 2015-2016, Leah participated in a show *called ROT: The Afterlife of Trees*, which was a collaboration between artists and scientists that investigated what happens after a tree 'dies.'

On the next slide you will see Leah Wilson's 3-dimensional exploration of fungus, called *Recompose*.



Recompose – Leah Wilson

Window-like holes created by insects open into the interior of a log revealing ribbons of cubical brown rot, cellulose long gone. Fungus, like an old scab with edges curling and dry, has been transforming the log that became part of the architecture of the creek many floods in the past. I manipulated the size of the fungus to 36 times its actual size and isolated it from its original surroundings of the log to investigate it without distraction. Most of this fungus is hidden. I increased the scale to be able to explore the structure of the fungus beyond the form that is accessible to my eye and I have found that it has a honeycomb structure that is simultaneously exquisite and grotesque.

Similar to the fungus Leah Wilson explored on the previous slide, young western hemlocks and shrubs like red huckleberry also absorb nutrients and water from decomposing logs. The nutrient-rich logs these plants feed and grow on are called "nurse logs," and you can see them throughout the forest, wherever a tree is growing out of a decaying stump or log. In fact, in this spot alone you can see several nurse logs of varying ages. The young nurse logs are pretty easy to spot, because their shape is still defined. Can you spot some of the old ones?

If you are stumped you can jump forward to the next slide to see examples.

Notice the signs of decomposition (decay) taking place all around this spot. What facilitates the process of decomposition? *On your handouts* c*lick on all that apply.*

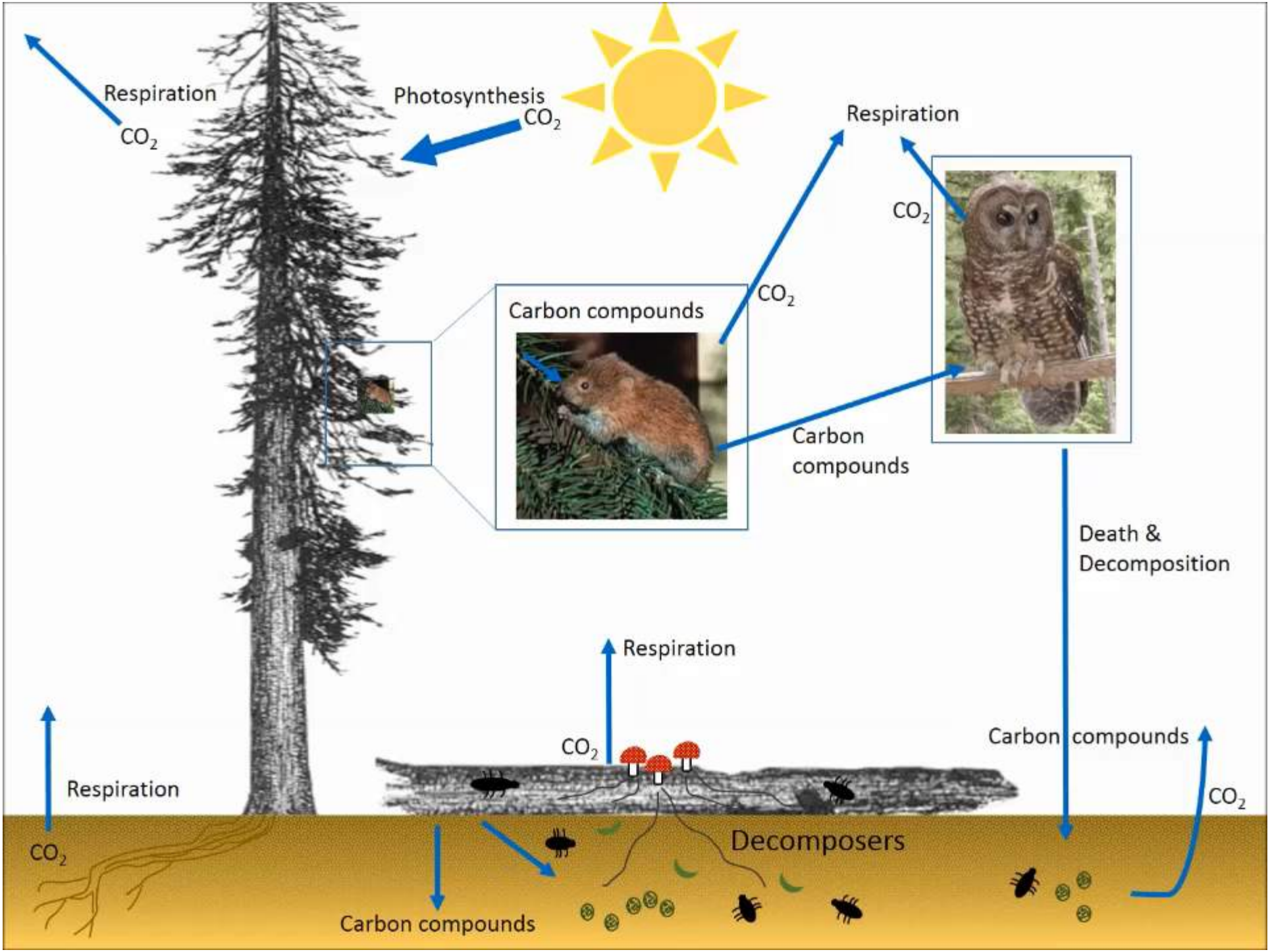
☐ Water	☐ Time	☐ Animals
☐ Fungus	☐ Sunshine	☐ Wind

Young

Old

Get down low and look closely at the ground or at the surface of a downed log. You might see a beetle, a millipede, a slug, or a mushroom. We often think of these organisms as pests. Yet these decomposers (and others we can't see, like bacteria) actually benefit the forest by breaking down dead plant and animal debris into nutrients needed by plants for growth. Water, time, sunshine, and fungus all contribute to the process of decay, as well. Decomposers keep nutrients cycling; without them, life in the forest could not continue.

Press ***PLAY*** on the following slide to see a video diagram of the decomposition process as an element of the Carbon cycle.


Respiration
CO_2
Photosynthesis
CO_2
Respiration
CO_2
CO_2
Carbon compounds
Carbon compounds
Death &
Decomposition
Respiration
CO_2
Respiration
CO_2
Carbon compounds
CO_2
Decomposers
Carbon compounds

At any point in time, a forest ecosystem may take in more carbon from the air through photosynthesis than is released through the respiration and decomposition of all the organisms. In this case we call the ecosystem a **carbon sink** for atmospheric carbon. Other forests are actually releasing more carbon into the air than is captured by photosynthesis, and these ecosystems we call a **carbon source**.

What kinds of forest would you expect to be carbon sinks? Carbon sources? (on your handouts check the source or sink box for each type of forest, below)

	Sink		**Source**
☐	☐	Recently logged forest	☐
	☐	Old growth forest	☐
	☐	Burned forest	☐
	☐	80 year old plantation	☐
	☐	120 year old forest established after fire	☐
	☐	20 year old plantation	☐
	☐	Forest experiencing large insect outbreak	☐

We often hear about carbon sources, sinks and sequestration in relation to climate change. A forest that is a carbon sink is sequestering carbon – in a given year more carbon dioxide is taken up through photosynthesis than is released through respiration. The climate change problem boils down to too much carbon dioxide in the atmosphere. Every year, forests around the world sequester a small fraction of the carbon that we release into the atmosphere through burning of fossil fuels. What is even more important for climate change is the total amount of carbon that is stored in forests instead of as carbon dioxide in the atmosphere. More carbon stored in live and dead wood means less carbon dioxide to drive the process of global climate change.

Which type of forest stores more carbon?

☐ A carbon sink
☐ A carbon source
☐ That is a bogus question

Yes, that was a bogus question, because we didn't provide you enough information to answer it. A young forest plantation may be growing rapidly and sequestering carbon, but it may take hundreds of years for that forest to store as much carbon in trees, dead wood and in the soil as is stored in an old growth forest, even if the old growth forest were to release as much carbon as it stores in any particular year. When large areas of old growth forests were clearcut in the 1940s through the 1980s, vast amounts of carbon were released into the atmosphere.

Listen to forest ecologist and decomposition expert Mark Harmon describe carbon storage in old growth and young forests.

Trail Stop #5
Lookout Creek

Swipe left/right to navigate

Click the large play button in the upper right to begin

Salmon Boy

from *Keepers of the Animals*

by Michael J. Caduto and Joseph Bruchac

a story of the Pacific Northwest Haida Tribe

Group read the story

One person reads 1-2 paragraphs aloud, then passes the tablet around to the next person, taking turns in the group until the story is complete.

Salmon Boy

(Haida Tribe – Pacific Northwest)

(From Keepers of the Animals by Michael J. Caduto and Joseph Bruchac)

Long ago, among the Haida people, there was a boy who showed no respect for the salmon. Though the salmon meant life for the people, he was not respectful of the one his people called Swimmer. His parents told him to show gratitude and behave properly, but he did not listen. When fishing he would step on the bodies of the salmon that were caught and after eating he carelessly threw the bones of the fish into the bushes. Others warned him that the spirits of the salmon were not pleased by such behavior, but he did not listen.

One day, his mother served him a meal of salmon. He looked at it with disgust. "This is moldy," he said, though the meat was good. He threw it upon the ground. Then he went down to the river to swim with the other children. However, as he was swimming, a current caught him and pulled him away from the others. It swept him into the deepest water and he could not swim strongly enough to escape from it. He sank into the river and drowned.

There, deep in the river, the Salmon People took him with them. They were returning back to the ocean without their bodies. They had left their bodies behind for the humans and the animal people to use as food. The boy went with them, for he now belonged to the salmon.

When they reached their home in the ocean, they looked just like human beings. Their village there in the ocean looked much like his own home and he could hear the sound of children playing in the stream which flowed behind the village. Now the Salmon People began to teach him. He was hungry and they told him to go to the stream and catch one of their children, who were salmon swimming in the stream. However, he was told, he must be respectful and after eating return all of the bones and everything he did not intend to eat to the water. Then, he was told, their child would be able to come back to life. But if the bones were not returned to the water, that salmon child could not come back.

He did as he was told, but one day after he had eaten, when it came time for the children to come up to the village from the stream, he heard one of them crying. He went to see what was wrong. The child was limping because one of its feet was gone. Then the boy realized he had not thrown all of the fins back into the stream. He quickly found the one fin he had missed, threw it in and the child was healed.

After he had spent the winter with the Salmon People, it again was spring and time for them to return to the rivers. The boy swam with them, for he belonged to the Salmon People now. When they swam past his village, his own mother caught him in her net. When she pulled him from the water, even though he was in the shape of a salmon, she saw the copper necklace he was wearing. It was the same necklace she had given her son. She carried Salmon Boy carefully back home. She spoke to him and held him and gradually he began to shed his salmon skin. First his head emerged. Then, after eight days, he shed all of the skin and was a human again.

Salmon Boy taught the people all of the things he had learned. He was a healer now and helped them when they were sick.

"I cannot stay with you long," he said, "you must remember what I teach you."

He remained with the people until the time came when the old salmon who had gone up stream and not been caught by the humans or the animal people came drifting back down toward the sea. As Salmon Boy stood by the water, he saw a huge old salmon floating down toward him. It was so worn by its journey that he could see through his sides. He recognized it as his own soul and he thrust his spear into it. As soon as he did so, he died.

Then the people of the village did as he had told them to do. They placed his body into the river. It circled four times and then sank, going back to his home in the ocean, back to the Salmon People.

In 3-5 sentences, as a group describe the relationships Pacific Northwest Native Americans have with water, fish, and nonhuman nature, as they are portrayed in the story.

_____(short answer)_____

How are these relationships similar to or different from your relationships to water, fish, and nonhuman nature? (*Each group member shares 1-3 sentences*.)

Group Member 1 _____(short answer)_____
Group Member 2 _____(short answer)_____
Group Member 3 _____(short answer)_____

What is the purpose or takeaway of this story? 1-2 sentence response. (Hint: there is no right answer! *Everyone should respond.*)

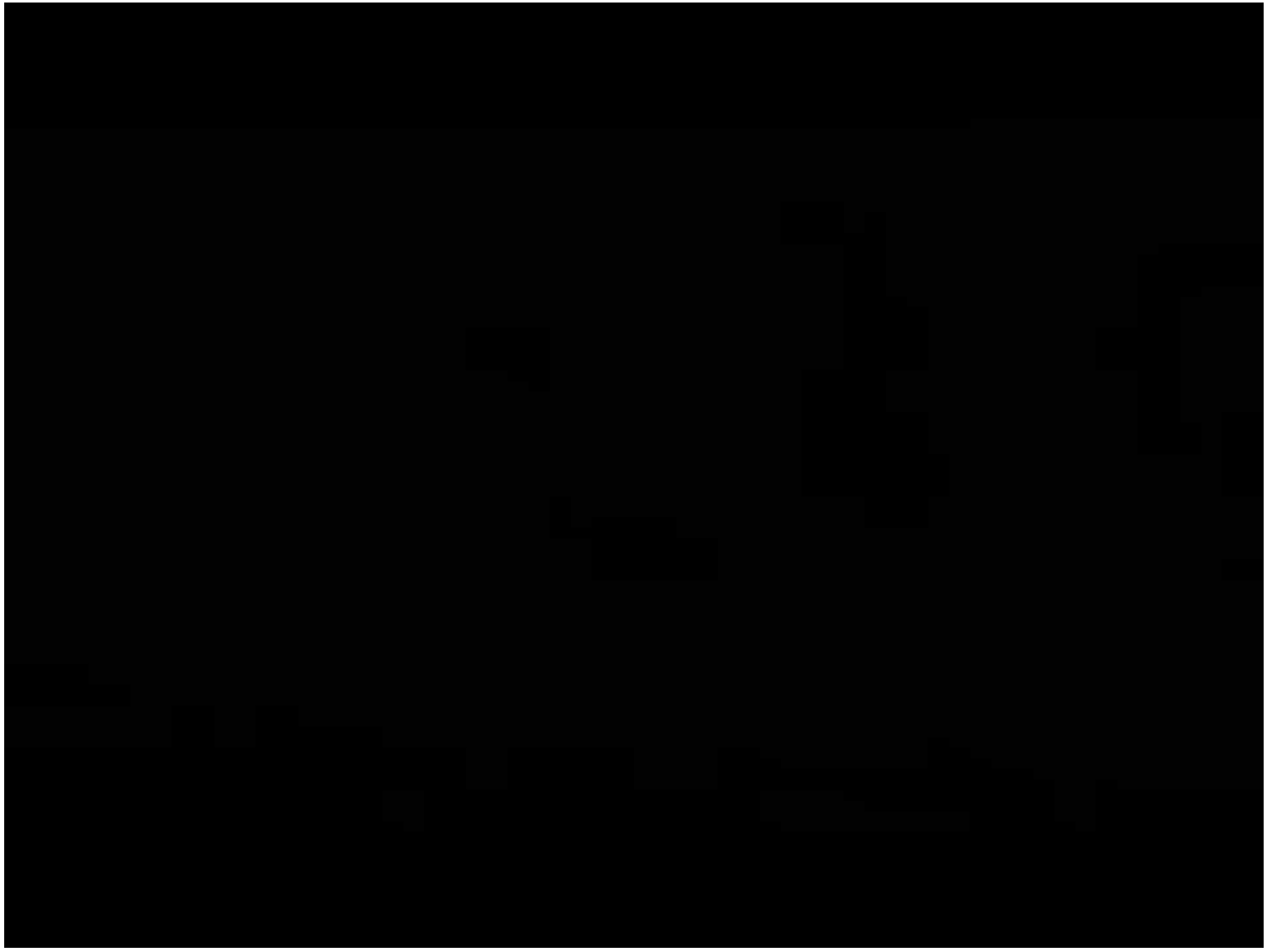
Group Member 1 _____(short answer)_____
Group Member 2 _____(short answer)_____
Group Member 3 _____(short answer)_____

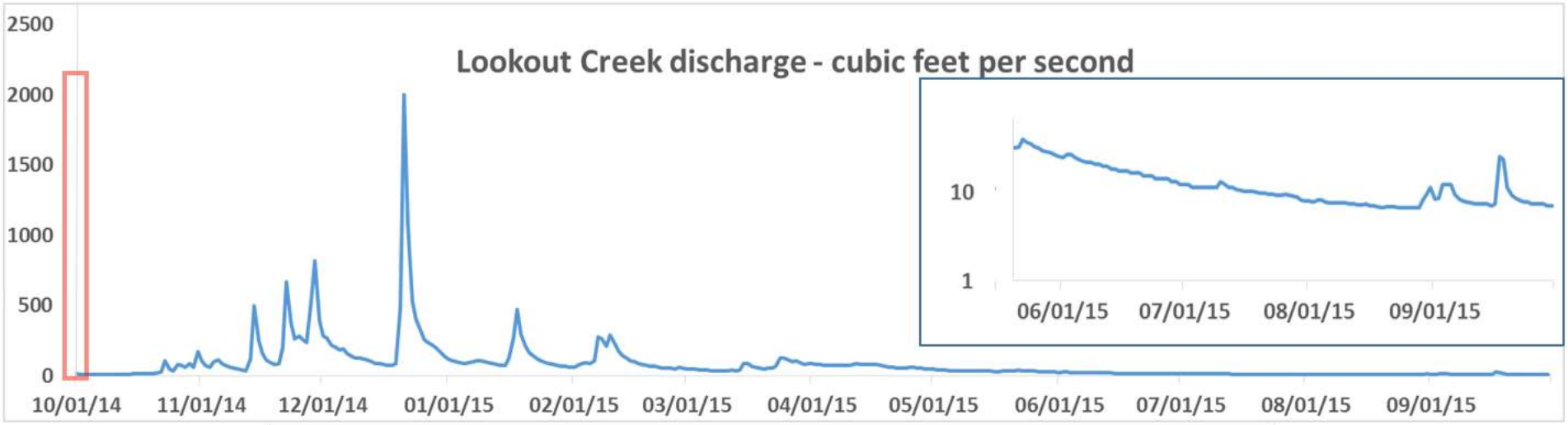
Do you relate to Salmon boy? Why or why not? 2-4. sentence response. (*Everyone should respond.)*

Group Member 1 ☐Yes ☐ No _____(short answer)_____
Group Member 2 ☐Yes ☐ No _____(short answer)_____
Group Member 3 ☐Yes ☐ No _____(short answer)_____

Fish, especially salmon and trout, are synonymous with Oregon. Protecting habitat for these iconic species depends on conditions in both the stream and the surrounding forest, and requires close attention to shade, logs in the water, and erosion of the forest floor. This kind of management is addressed with the Oregon Plan for Salmon and Watersheds, passed in 1997 and administered by the Oregon Watershed Enhancement Board (OWEB). Here in Lookout Creek cutthroat and rainbow trout are two of the nine native fish species. Researchers have studied trout populations for many decades in order to understand stream food webs, and how to manage the land for healthy stream ecosystems.

Click play to watch a short video by Corvallis filmmaker Jeremy Monroe of stream invertebrates, which are the main food source for trout in Lookout Creek and play key roles in both aquatic and terrestrial food webs.




Lookout Creek discharge - cubic feet per second
2500
2000
1500
1000
500
0
10/01/14
11/01/14
12/01/14
01/01/15
02/01/15
03/01/15
04/01/15
05/01/15
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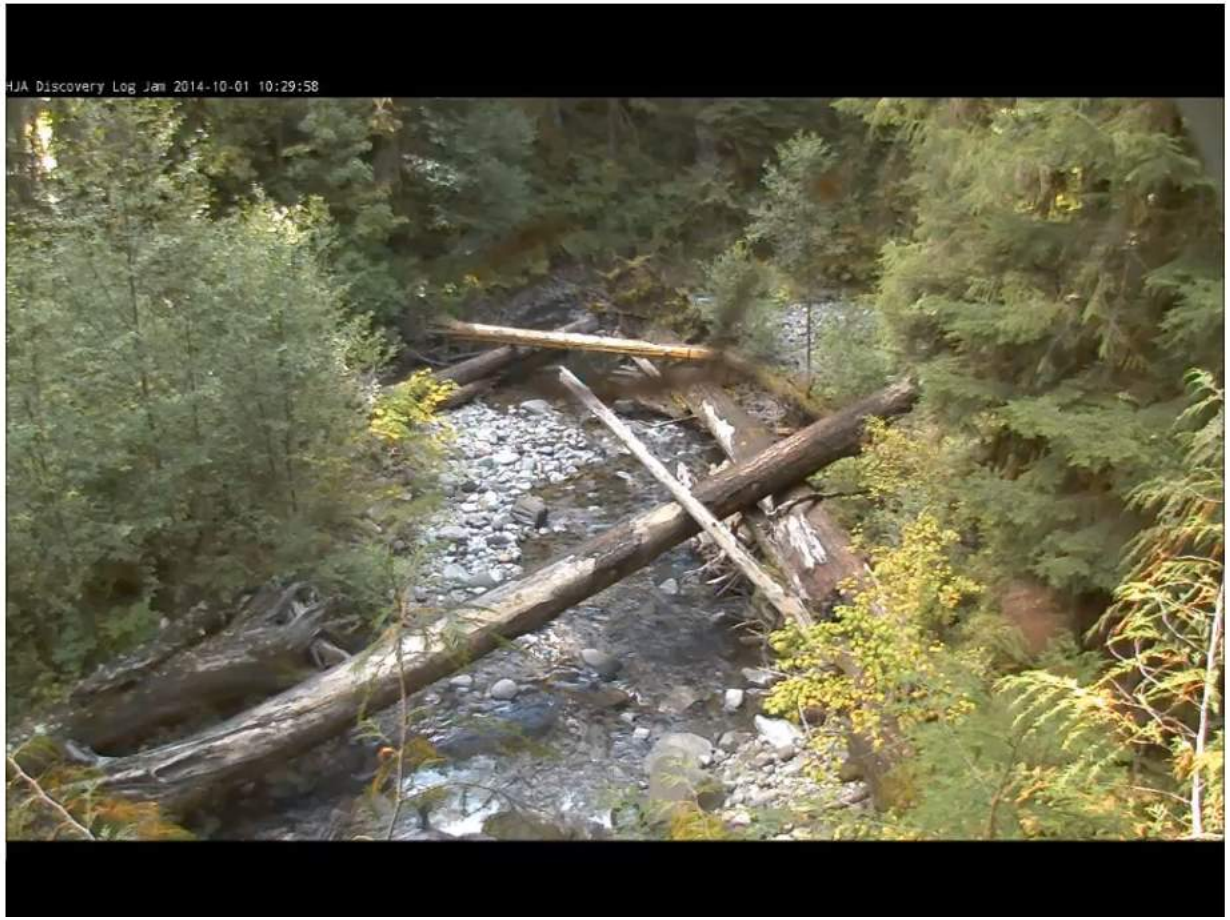
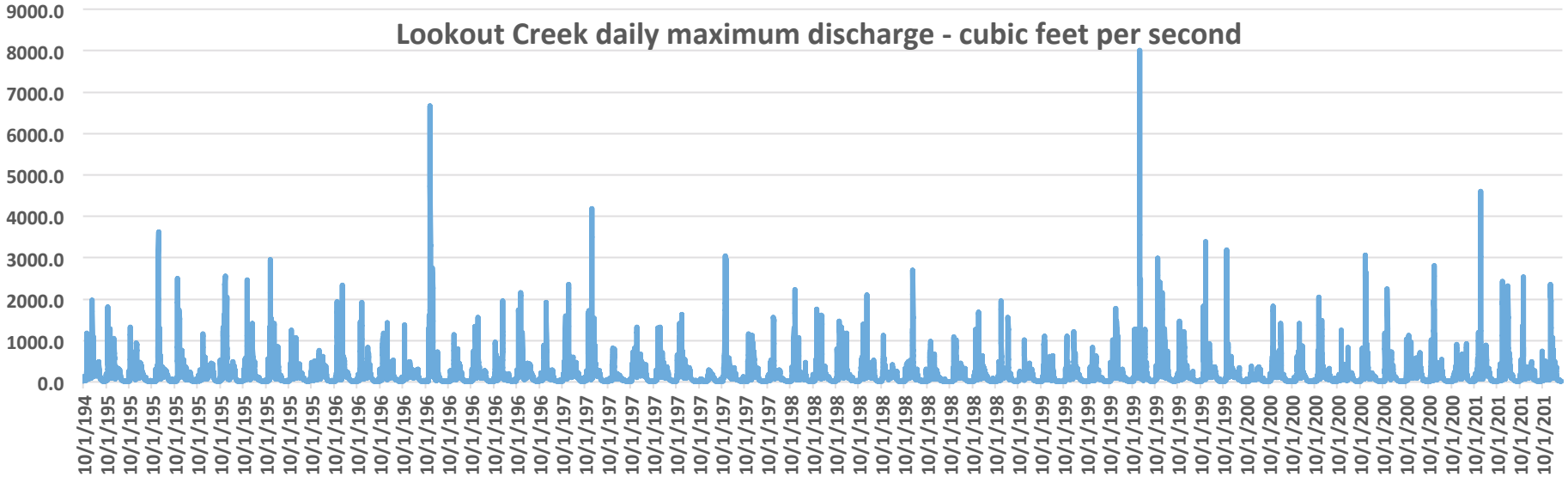

HJA Discovery Log Jam 2014-10-01 10:29:58

What might contribute to flood events on Lookout Creek?

☐ a. Rainstorms
☐ b. Nature is sad and crying
☐ c. Blockage in a stream or river
☐ d. The shape of the landscape
☐ e. Snowmelt
☐ All of the above
☐ All of the above except ‘b’
☐ All of the above except ‘b’ and ‘c’

12/21/2014 flood

This is what is feels like to be on the logjam during a moderate flood



A) Compare the winter 2014 flood (in the video) to other flood events recorded on Lookout Creek in the previous 65 years. Remember that the maximum discharge on December 21, 2014 was 2000 cubic feet per second (CFS).

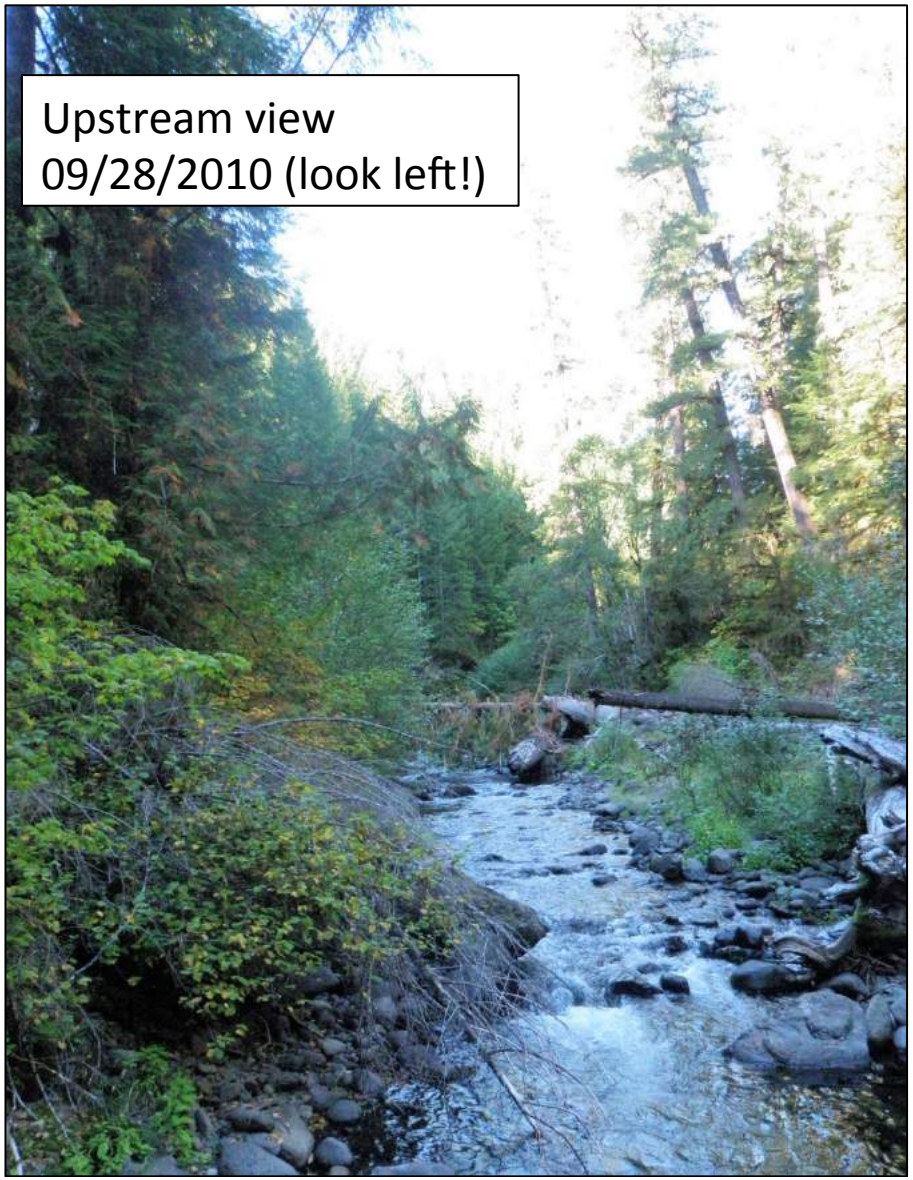
- Is a flood that size common? Y ☐ N ☐
- In roughly what percentage of the years did we record a flood at least 2000 CFS?
  5% ☐ 10% ☐ 20% ☐ 30%☐ 50%☐ 75% ☐ 90% ☐
- How many years had flows at least twice as great?
  1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 8 ☐ 10 ☐

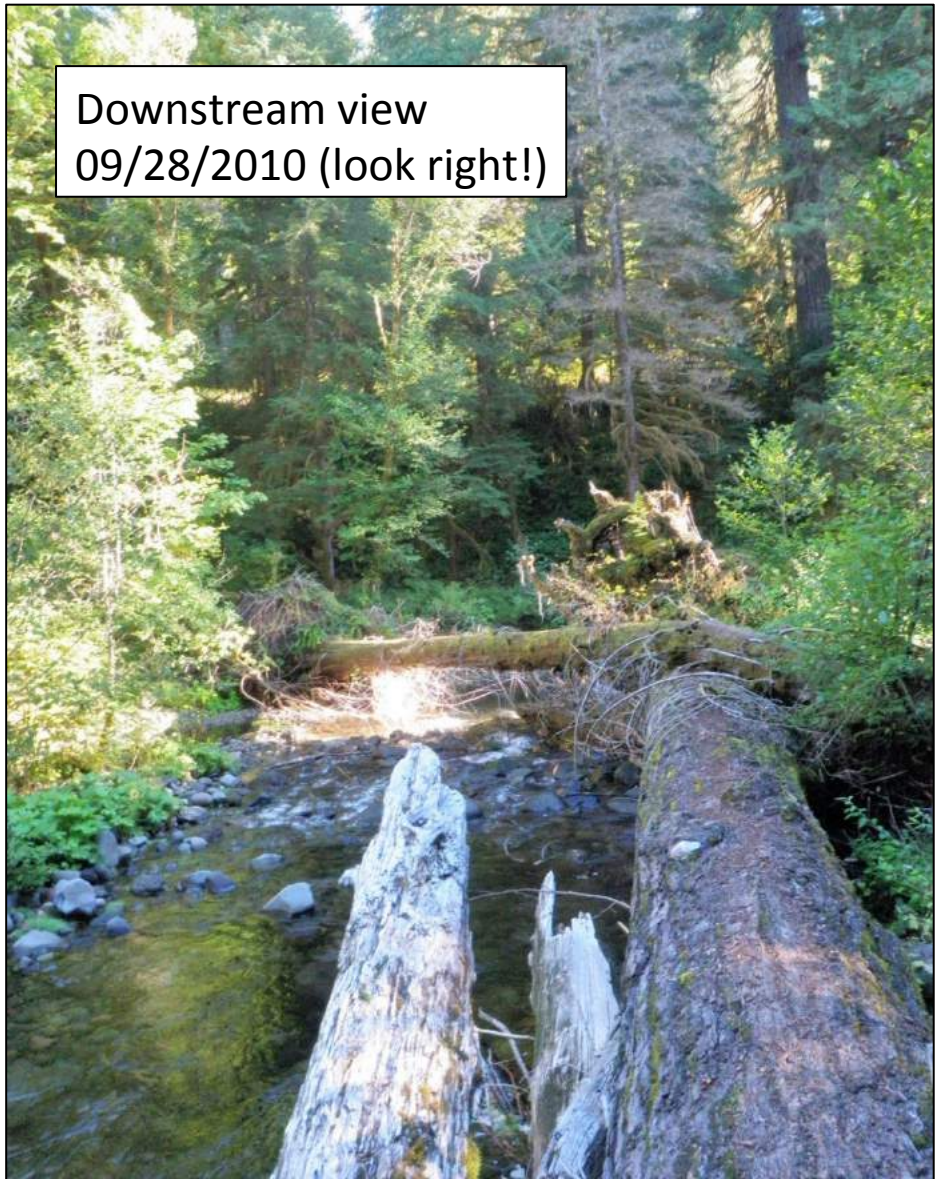
B) In 2011, the maximum flow was 4,600 CFS. Based on your observations of the creek at 2000 CFS (in the videos at 2000 CFS), what do you think happened here with more than twice the flow in 2011? Group response. 3-5 sentences.

_____short answer_____

Compare this photo from this spot in September 2010 to what you see here now.

- Has the logjam changed? Explain 1-3 sentences (*group*) _____short answer_____
- Has the stream channel moved? Explain 1-3 sentences (*group*) _____short answer_____
- How did the flood impact the trees on the edge of the creek ? Explain 1-3 sentences (*group*) ____short answer _____





Osprey and trout are 2 important native species that rely on the stream ecosystem for food, habitat, and protection. Water levels depend on a number of factors and can fluctuate dramatically throughout the year, as you saw in video from the seasonal in Stop #2.

A) How might trout be impacted by flood conditions? *Group response*. 1-3 sentences.

_____short answer_____

Major floods often are assumed to have negative effects on fish populations; major rearrangement of substrates and powerful water velocities have been hypothesized to injure fish or wash them downstream. However in the summer after the big 1996 flood, trout populations in a long-term study at the Andrews dramatically increased. Compared to previous years, trout population densities in after the flood were the highest measured, and young fish showed especially high densities post flood. The especially high densities of young fish resulted in increased numbers of adult fish the following years. Increases in young fish post flood were thought to be the result of increased habitat availability. Removal of fine silt from stream sediment, deposition of spawning gravels along the stream margin, and increased refuges for young in new wood accumulations are all possible contributors.

How might the landscape be impacted by flood conditions? Group response. 1-3 sentences.

_____short answer_____

How might downstream humans be impacted by flood conditions? Group response. 1-3 sentences.

_____short answer_____

Trail Stop #6
Canopy Critters

Swipe left/right to navigate

Click the large play button in the upper right to begin

What is an old growth forest?

☐ **A**) A forest with complex structure, old trees and large dead wood
☐ **B**) A forest that was planted generations ago
☐ **C**) A forest that has never been significantly harvested
☐ **D**) A place full of gnomes and sprites
☐ All of the above
☐ B and C
☐ A and C

You are standing in an old growth forest . What do you observe about how this place feels? Consider temperature, light, ground feel, understory, and canopy.

_____(short answer)_____

Why might we need or appreciate old growth forests?

_____(short answer)_____

Given those values of old growth forests, why might we need or appreciate young forests, many of which have been planted by forest managers?

_____(short answer)_____

In the videos that follow you will meet two of the species that live in old growth forests. Pay attention to how these species interact with the forest. What about their life history makes them well-suited to old growth?


The Red Tree Vole
An arboreal herbivore
Video footage provided by
Eric Forsman


Spotted Owl
footage provided by John Liu
Reading by author Tim Fox

Conservation of old growth and old-growth dependent species

Scientists monitor populations of predators like the Northern spotted owl as an indicator of the overall health of the ecosystem. At the Andrews, scientists have been studying spotted owls since the 1970s.

In 1990, when the Northern spotted owl was listed as a threatened species, some understood their status as representative of more widespread problems in the forest resulting from extensive clearcutting of old growth forests. The protection of the old- growth dependent Northern spotted owl led to drastic changes in forest management practices, a reduction in timber harvest in the Pacific Northwest and the establishment of old-growth, or late-successional, reserves.

Conservation of old growth and old-growth dependent species

While the changes in management practices have preserved much of the remaining Northern spotted owl habitat, spotted owl numbers continue to decline. Evidence shows they are being out-competed for resources by Barred owls, a species whose range has expanded into the Pacific Northwest in recent decades, perhaps due to land use changes in other parts of the U.S. and Canada, though this suggestion is debated.

Barred Owls are larger and more aggressive than the Northern spotted owl. Because Barred Owls can use both old growth and young forest habitat, as well as eat a broader selection of prey species, they displace the spotted owl from its prime habitat.

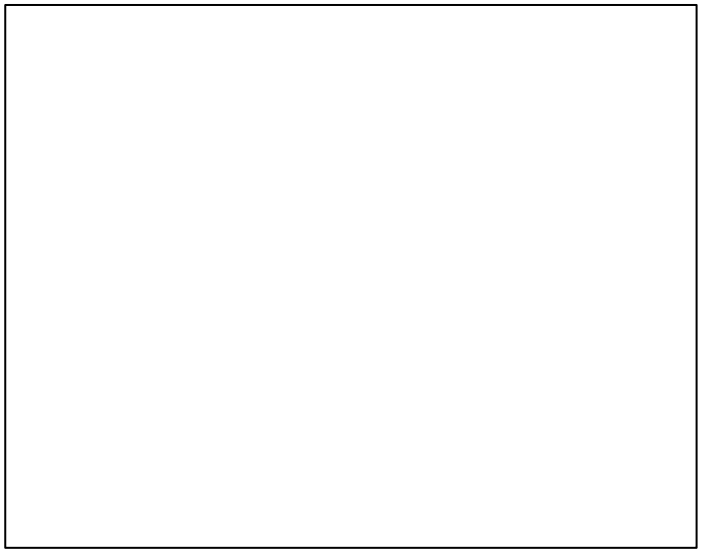
The case of the Spotted owl illustrates the complexity of ecological interactions. People often play a key role in ecological processes through management activities, population growth, and lifestyle choices, whether we fully understand our role or not.

click here for guided narration to imagine the perspective of an old growth species

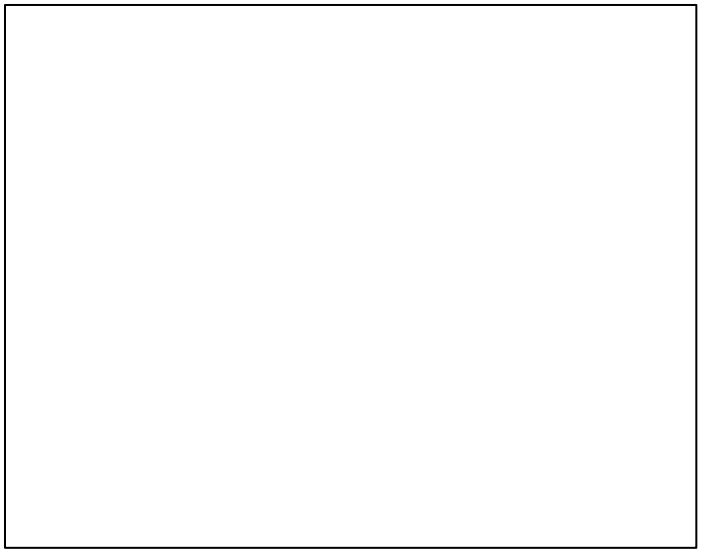
Animal perspective storytelling

Use your imagination to inhabit the perspective of a red tree vole or a Northern Spotted owl. Then use text or drawings to fill in the 8 panels on your handout to create a story board or comic strip that captures the activities, lifestyle, and experience of your animal in the forest. Feel free to use dialogue, narration, scene setting, description, or images to tell your story!

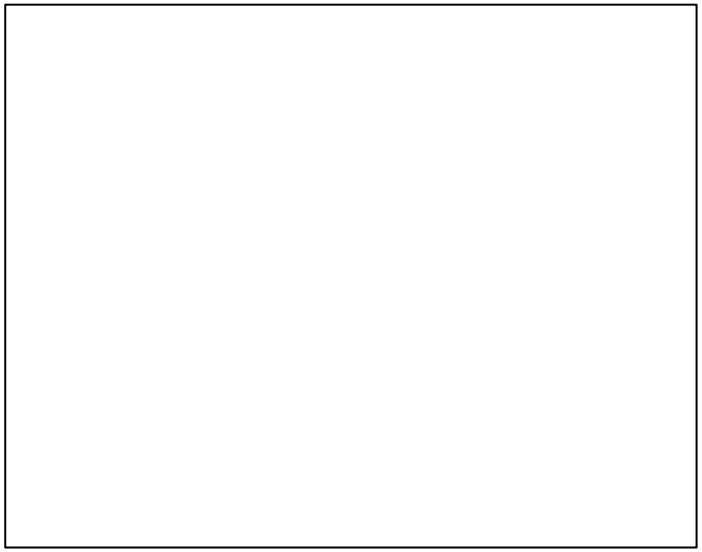
Animal perspective storytelling



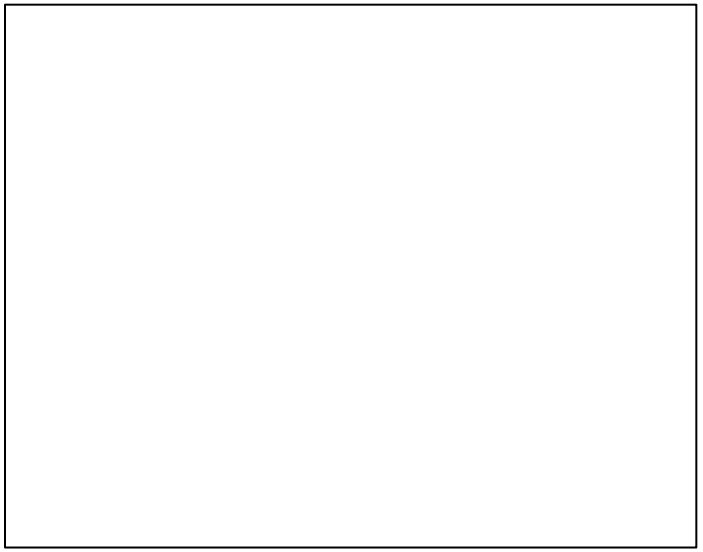
Habitat



Family, community

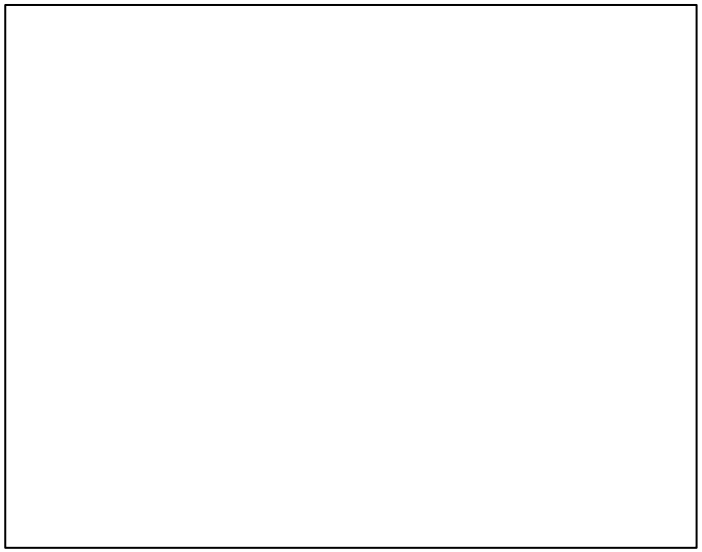


Food source

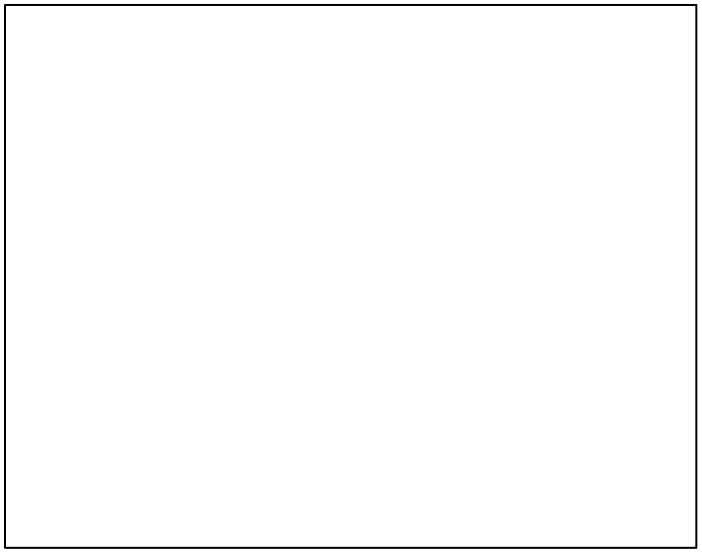


Feeding activities

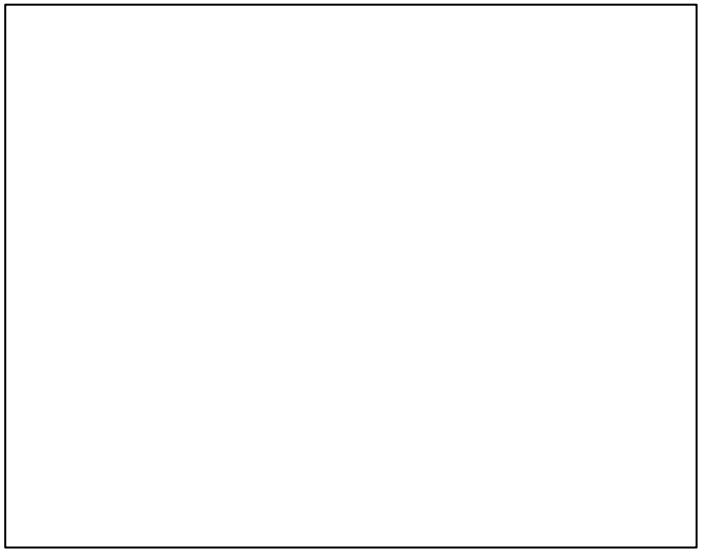
Animal perspective storytelling



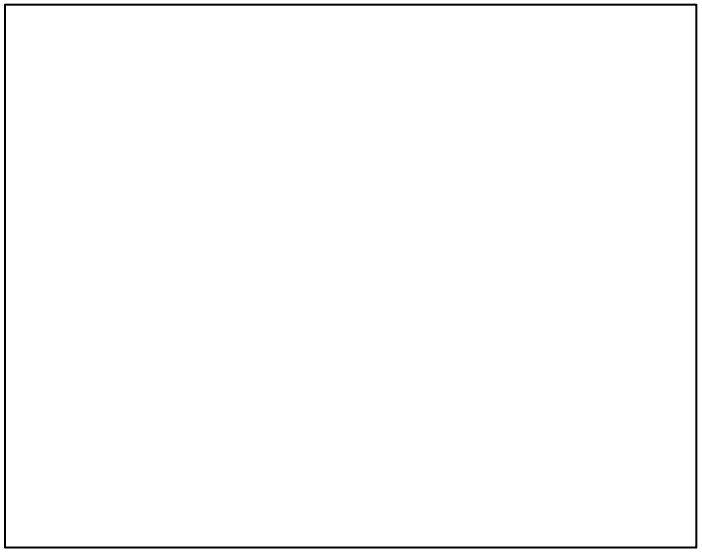
Safety and comfort



Interspecies interactions



Forest exploration



After dark activities

Trail Stop #7
Forest Management

Swipe left/right to navigate

Click the large play button in the upper right to begin

You have just walked into a different forest stand.

What do you observe about how this forest feels? How does it feel different than the old growth forest? Consider temperature, light, ground feel, understory, and canopy.

_____(short answer) _____

How do you think your organism from the last stop would respond to this habitat

_____(short answer)_____

Click play on the next slide to watch Andrews researcher Fred Swanson describing forest management history in the Pacific Northwest at the site of a 12-year-old plantation on private timber land near the Andrews Forest

Fred described three periods in forest management history on public lands in the pacific northwest. In which period do you think this stand was established and what were the forest values that were considered most important by managers and society at that time?

_____(short answer)_____

Forest plantations are tree stands planted by people for the primary goal of wood production. This plantation was established after a timber harvest in 1960. If you break out your eagle eyes again and look around you can find clues about what the previous forest looked like.

Fred mentioned that the current era of federal land management there is an emphasis on maintaining ecosystem functions, often thought of as ecosystem services. "**Ecosystem services** are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth.Fred gave an example of managing forests in such a way that we maintain water quality and habitat for aquatic species." *(United Nations Environmental Programme (UNEP)*

What decisions might forest managers make to accomplish the goal of maintaining that ecosystem service?

_____(short answer)_____

Water quality is only one of many potential ecosystem services from forest lands. What are some others that occur to you?

_____(short answer)_____

If managers were to make water quality the only priority for maintaining ecosystem services from forests, some other ecosystem services would likely still be maintained, whereas other services would have to be sacrificed or reduced. What ecosystem services do you think would be sacrificed?

_____(short answer)_____

Take a tour with Fred of a plantation that is a similar age to the one in which you are standing. Pay attention to the differences and similarities between Fred's stand and this one, as Fred describes the history of the stand and the ecosystem services that managers were trying to balance with the treatment of that stand.

Fred mentioned a number of ecosystem services that factored into the recent thinning of the stand in the video. Assess how the thinning treatment affected each ecosystem service below relative to an un-thinned plantation of similar age, like the one in which you are standing.

	> in thinned stand	No difference	> in unthinned stand
Carbon sequestration	☐	☐	☐
Provision of forest products	☐	☐	☐
Development of large trees & old growth structure	☐	☐	☐
Habitat diversity	☐	☐	☐
Biodiversity	☐	☐	☐
Current spotted owl habitat	☐	☐	☐
Future spotted owl habitat	☐	☐	☐
Carbon storage	☐	☐	☐

What do humans need from forests?

_____(short answer)_____

What do other animals need from forests?

_____(short answer)_____

- Why might humans value forests? *Check all that apply.*
- ☐ Wood products
- ☐ Shade
- ☐ Clean water
- ☐ Carbon storage
- ☐ Peace and quiet
- ☐ Beauty
- ☐ Place for animals to live
- ☐ Hiking and camping
- ☐ The potential for medicines
- ☐ Inspiration and wonder
- ☐ Food
- ☐ Clean air
- ☐ Inspiring
- ☐ Other? (*please describe*) --------

  _____

How do forests make you feel?

Group member #1_____

Group member #2_____

Group member #3_____

In 1-3 sentences, share a short memory of a time when you felt awe, wonder, or inspiration in a forest or a natural area:

Group member #1_____

Group member #2_____

Group member #3_____

What do you appreciate or value about forests?

Group member #1_____

Group member #2_____

Group member #3_____

What are you still wondering about forests? What questions do you still have?

Each group member share 1 question about the forest or forest ecosystems

Group member #1_____

Group member #2_____

Group member #3_____

How would you go about finding an answer to one of those 3 questions? *Group response.*

- What do you want to know?
- What do you think you would find if you studied this question? What is your proposed hypothesis?
- What kind of information or data would you need to gather to conduct your investigation?

Did you learn anything new about forests today?

Group member #1_____

Group member #2_____

Group member #3_____

Trail Stop #8
SOUND MAPS: Listening Station

Swipe left/right to navigate

Click the large play button in the upper right to begin

Listening Station: Mindful Sound Mapping

Each student grab a notecard and a pencil from the cardholder.

Click here and listen to the recorded instructions

Trails stop #9
How many shades of GREEN?

Swipe left/right to navigate

Click the large play button in the upper right to begin

How Many Shades of Green?

Each student or student group takes 1 paint palette strip from the trail stop post.

With your group, walk the trail in either direction from the trail stop.

- How many shades of green can you find? Match the palettes on your paint strip to the foliage of the forest.
  - Can you find all of the colors on the strip?
  - Can you find a perfect match?

Ask group members to verify your matches. Use the tablets to take photos so you can compare your matches with other groups!

Spend about 5-10 minutes exploring the foliage along the trail, until everyone has had sufficient time to peruse the area thoroughly, and then re-group at the post to answer a few questions.

With your group discuss what you noticed about the forest when you looked at the foliage with such deep attention to color.

Did it make you look at your surroundings differently? ☐Yes ☐No
If yes, explain:_____

Did you see things you might have missed before? ☐Yes ☐No
If yes, explain:_____

Did you notice that certain colors were more likely to be found above your head or below? ☐Yes ☐No

If yes, explain. *Group response*_____

What was this experience like for you?
Group Member #1 _____
Group Member #2 _____
Group Member #3 _____

Trails stop #10

Nature Journaling: Learning to See and Seeing to Learn

Swipe left/right to navigate

Click the large play button in the upper right to begin

- *ACTIVITY*

You will draw a single plant in two different ways to get to know the plant, train your senses of perception, and learn to tell a story of place through image.

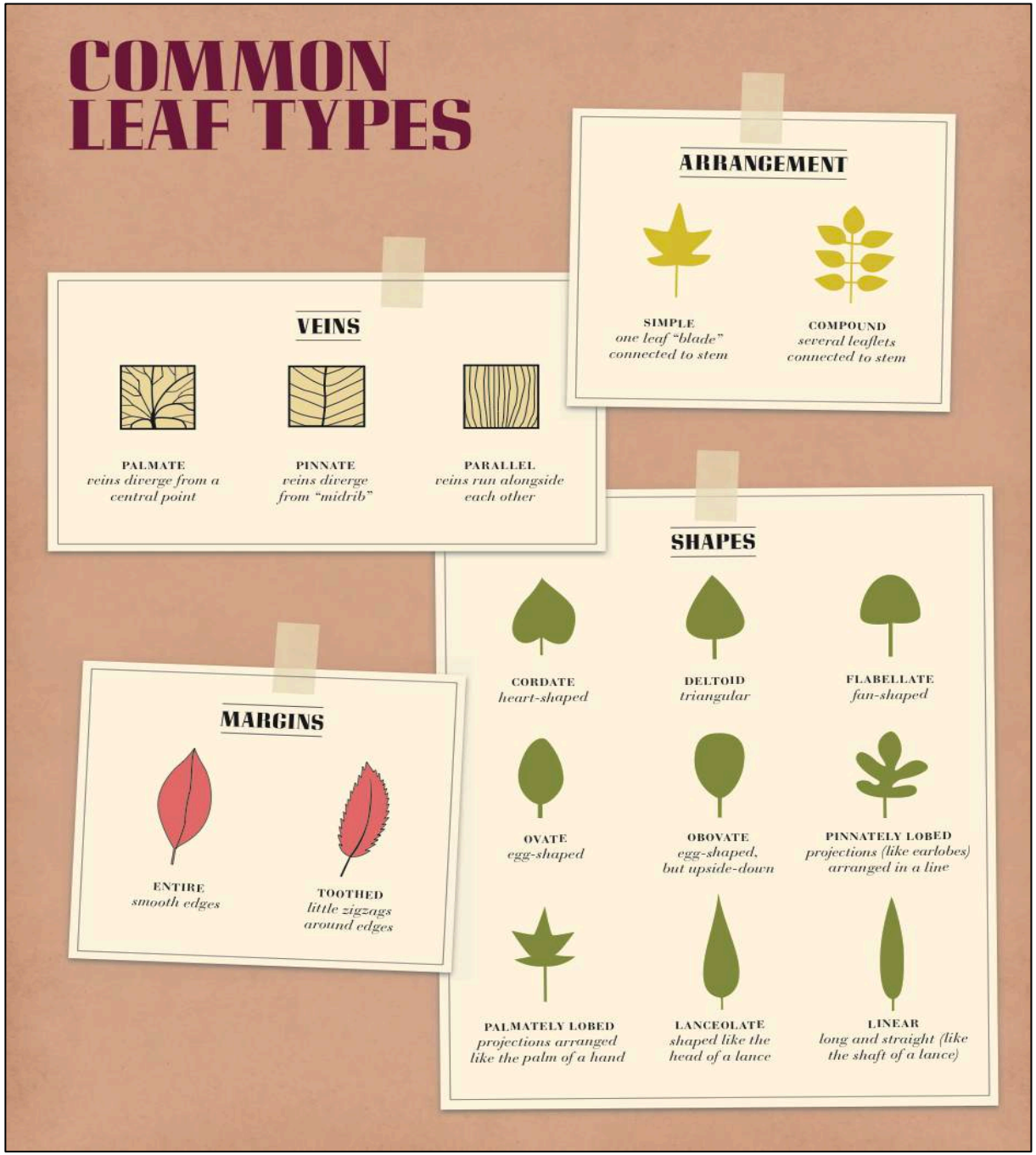
- MATERIALS

Paper, pencil, hand lens, guidebook

- *OBJECTIVE*

The purpose of this activity is to practice the skills of observation and perception. The goal is not to be a 'good' artist or create a 'pretty' picture, so much as it is to collect information about a specific plant. Good science about the natural world requires good images and written descriptions, and these skills are just that: skills that require practice, patience, and training. Plus, it's fun!

Notice! You can return to this image for reference while you draw

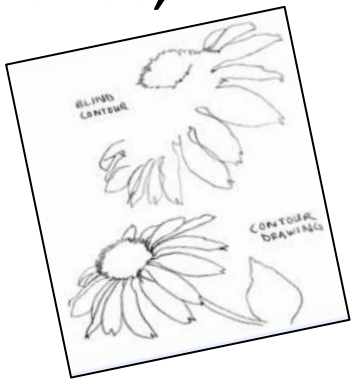


SET UP: 5 minutes

- Choose a plant that you can see clearly and get up close and personal with.
- Spend 1-2 minutes observing your plant from all angles. Record notes on what you see:
  - How many leaves? What colors are all the different pieces? Where is it growing: In a sunny spot? Near other plants? In a dry or wet area? How are the petals and/or the leaves shaped? How are they arranged? Where do the leaves emerge from the stem, and at what intervals? What is the shape of the veins in the leaves?
- Observe closely (with your hand lens!) to take note of textures, shapes, density; Observe from a distance to take note of the whole form, the way it moves, bends, and interacts with light.
- Use the guidebook to try to identify this plant (hint: leaf shapes are a good place to start!)
- Decide which direction to orient drawing paper: landscape (long) or portrait (tall).
- Choose a starting point: the bottom of the stem? The center of the flower?

DRAWING 1: Blind Contour Drawing 3 minutes

- Put your pencil on the paper.
- To start, concentrate on a single area. Keep your eyes on your plant, not the page. Remember, this is an exercise in seeing!
- Draw your plant without picking your pencil up from the page!
- Don't get stuck on what it looks like—remember, you're looking at the plant, not your drawing!—and instead try to *feel* the contours, shapes, textures, and details of your plant.
- Don't look until you're finished.



DRAWING 2: Contour Drawing 5 minutes

- This time make the plant *grow slowly*. Build your drawing as you keep checking how the plant is put together. *Look, check, and think one step ahead to see where you are going.*
- Pay particular attention to shapes (do the petals or leaves overlap?), edges, and joins.
- Start drawing with a light pencil stroke. Where the plant gets darker, use a stronger pencil line.
- This is still an outline, and you only have a few minutes. So rather than try to create a masterpiece, do your best to capture the essence of your plant. Try to spend more time looking at, learning about, understanding your plant, than looking at your page or worrying about the preciseness of your drawing.
- When you're finished compare your two drawings. What is the value of doing a continuous outline? What is the value of taking more time? How do both images tell a more complete story about your plant?