Forest Change Fast Facts

FACT: The state of things as they are (a thing that has actually happened or is true)
INFERENCE: An educated guess based on information you know to be true.
EXPERIMENT: Test with the purpose of discovering something unknown or to support an idea
VARIABLE: Something that may or does change.

Remember:

- Is the inference based on facts?
- Does the inference seem reasonable?
- Is the inference testable?
- Does this test prove or disprove the inference?
- Does the test help you create additional inferences?
- What is the main variable in the test? Are there additional variables?

Late-successional Coastal Forest

Northwestern Salamander

Marbled Murrelet

Facts

Use photo of late-successional forest stand to brainstorm/share what they know about forests, use animal photos to remind students who lives in the habitat.

LIGHT: Dominated by tall trees, layered canopy = very shady, openings made from a fallen trees provide sunny areas
AIR: Trees slow wind, except along forest edges and openings. Shade = cool temps
WATER: Fog and rain collect in tree branches and drip to ground.
SOIL: Lots of organics (needles, decaying leaves, tree trunks) makes lots of space for air and water in soil. Soil absorbs and holds water like a sponge.

Coastal temperate rain forests have:

- A complex structure including many different canopy layers and different age trees in a single stand.
- An abundance of epiphytes (plants living on the surface of other plants, such as lichens, mosses and ferns).
- Are unique in their abundance of coniferous trees which can grow year round. Have cool temperatures, short growing seasons and a short drought period in summer
- Few deciduous tree species and these are found primarily in disturbed areas (riverbanks, blow-down sites, clear-cuts, etc.) - deciduous tree need more light
- Half of their biomass made of dead trees, including snags and nurse logs (the making of organic soils!)

Northwestern Salamander

- Big eyes – sees well in dark places.
- Lives mostly underground in forests, also in soft/decaying logs, in bark or wood mounds around the bases of snags
- No teeth or claws
- Eats worms, beetles, slugs – anything it can catch and swallow
- One of the largest northwest salamanders

Variable that can cause Change

Late-successional forests are removed through wind storms, floods, logging and/or clearing for development. What happens to forest specialists, such as Northwestern salamanders?

Additional Facts

- Logging or clearing removes most woody debris from the site, unlike a natural event in which wood remains.
- Removing trees removes shade. Soil temperatures rise.
- Removing trees removes the canopy and dead wood that capture moisture. Soils dry and have less organic material in them.
- When trees return, or are planted, they are the same age and compete for sunlight. They will grow tall and skinny (creating a dog hair stand) and remove space and light for undergrowth of other plants.

Possible Inferences

- Less complex in forest structure means fewer snags/dead logs, no multilayer canopy or forest gaps, minimal understory plants (less plant and wildlife diversity)
- Specialists lose habitat. Marbled murrelets don't have big enough branches on which to nest or openings to fly in, bats and salamanders lose their shelter and food sources.
- When salamanders are faced with a choice in habitat, they will move towards and into areas that are dark, moist and easy to enter (soft).

Test/Experiment

Compare the habitat preference and behavior of Northwestern salamanders. Have two plastic tubs that simulate the soils of a late-successional forest (thick layer (at least 2 inches) of moist, organic forest soil and rotten wood) and a logged forest (thin layer (0.5 inch) of dryer forest soil).

Observation

The station instructor will place a Northwestern salamander in each tub. Students observe salamander behavior. What do they do, where do they go and why? Were the students' inferences correct?

What is the Refuge Doing to Help Forest Wildlife?

The Refuge is working in partnership with The Nature Conservancy to thin trees from previously logged areas. Thinning speeds up the process towards late-successional stand composition. Trees grow larger with less competition. Understory is more diverse with increased access to L.A.W.S. Returning forests more quickly to late-successional characteristics means more habitats for more species.

Freshwater Streams Change Fast Facts

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Stream

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Chum Salmon

Facts

Use stream and wildlife photos to brainstorm/share what they know about stream composition and wildlife. Pour stream water (including gravel, rocks, wood, plants and fish) into jar with large funnel to represent normal stream flow.

LIGHT: Streams often shaded by trees.
AIR: Moving water with riffles increases dissolved oxygen. Cold.
WATER: Fresh water. Streams are generally clear.
SOIL: Wet soils tend to be gravely in streams

Western Pearlshell Mussel

Streams have:

- Moving water
- Large woody debris, pool & riffles, and canopy shade. All important elements for cold, clear water needed by fish, mussels, invertebrates
- Experience frequent disturbance from high-flow events (e.g. flooding).

Western Pearlshell Mussel

- Live only in cold, clear streams with gravelly bottoms
- Use gills to filter algae, zooplankton and bacteria out of water
- Needs salmon and trout for reproduction – larvae attach to fish gills and are transported in stream

Chum Salmon

- Migrate upstream to fresh water to spawn
- Woody debris in streams protects fry from predation before they move downstream to estuary
- Need:
    - clear (low turbidity – suspended sediment), cold (shaded) water
    - gravel stream bottoms (spawning beds)
    - riffles (increased oxygen in water)
    - pools (resting areas)

Variables that may Cause Change

Road building, diking and development have altered stream flow (show photos of culvert).

Possible Inferences

- Culverts slows stream flow and cause sediment to fall out of water and collect on upstream side
- Culverts often clog and block flow large flood debris
- Culverts create barriers for fish (to small of an opening, water becomes too shallow, blocked by debris, raised about water column)
- Specialists lose habitat. Salmon cannot migrate upstream to spawn. Sediment buildup can cover spawning beds and freshwater mussel habitat.
- No salmon, no mussels.

Test/Experiment

Compare the "stream flow" of an obstructed channel with an unobstructed channel. Pour "stream water" through narrow funnel to represent stream flow through culvert.

Observation

Compare stream flow through culvert with unobstructed flow. What happens to gravel, woody debris and fish?

What is the Refuge Doing to Help Wildlife?

The Refuge works closely with County, State, Tribes and private landowners to replace small diameter culverts with bridges (or large diameter culverts) that span the full width of a stream (show picture). This helps re-establish natural stream flow and removes barriers to fish. Large woody debris has also been placed in streams to create pools, riffles and habitat.

Estuary Change Fast Facts

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Estuary

Littleneck Clams

Oysters

Facts

Use estuary and wildlife photos to brainstorm/share what they know about Willapa Bay and its wildlife. Use seawater chart to show the ingredients of bay water.

LIGHT: No trees or shrubs = very sunny. Shallow water means that light reaches to the bottom in most places
AIR: Open = very windy. Lack of shade = warm temps
WATER: Brackish water, tidal influence
SOIL: Sandy, muddy or gravely. Lots of dead and decomposing material.

Willapa Bay is

- shallow**,** with only a few deep channels at low tide
- characterized by open water, tidal cycles, salt marsh and tidal mud flats
- Salinity can change drastically – being more fresh when tide is out allowing river water to influence, higher when tidal waters from ocean inundate
- Dominated by eelgrass meadows (few bays exist like this on the Pacific Coast)

Littleneck Clams and Oysters

- Filter feeders – draws water through siphon and gills to filter out plankton and detritus from water.
- As larvae they swim and considered zooplankton
- Hard shells protect adults from predators

Seawater and Shell Building Facts

- Seawater contains many minerals and substances including chloride, sodium and calcium.
- Many animals create protective shells out of calcium and other similar minerals they extract from seawater and secrete from their bodies. Clams, oysters, crabs, etc.
- Calcium is basic (show pH chart). Calcium is used in antacids to help/change an acid stomach.

Variables that may Cause Change

The amount of carbon dioxide (CO2) in the air is increasing with time at a high rate. CO2 is absorbed in sea water.

Additional Facts

- Additional CO2 is being created by humans (vehicles, industry) and increased incidence of fire.
- Increase CO2 changes the pH of water – making it more acidic (show pH chart)

Possible Inferences

- Increased acid in sea water (lower pH), decreases calcium available for wildlife
- Plankton with calcite shells decrease.
- A lower rate of calcite accretion in clams, mussels and oysters slows growth.
- Specialists do not adapt quickly.

Test/Experiment

Compare the effects of normal bay water, and bay water that has increased acidity, on calcium. Put calcium tablet in regular bay water. Then add vinegar to bay water (decreased pH = more acid).

Observation

Compare how quickly tablet dissolves in regular bay water as compared to bay water with higher acid.

What is the Refuge Doing to Help Wildlife?

Refuge staff integrates climate change/ocean acidification awareness into management activities, including enhancing and maintaining robust habitats that can withstand change. Refuges partner with organizations, agencies and people like you to encourage wise use of resources to slow carbon emissions.