Report Writing Presentation Notes

* Run Slide show
	+ - Show Video <http://www.ted.com/talks/suzanne_simard_how_trees_talk_to_each_other?utm_source>
			* + Can end Video at 13:10 or at 15:30
		- Intro Project Questions
		- Intro Abstraction
		- Intro Networking Models
		- Intro Elements of Report Format
		- Pass out activity Sheets With Tape/scissors
		- Pass out corrected sheet as they leave
		- Any left over time have teams talk with each other about what is their project question and what do they want to ask mentors at Meet the Scientist

Definition: A **genet** is a colony of plants, fungi, or bacteria that come from a single genetic source.

**PREMISE OF TALK\*\*\*Video is Final Report at Expo**

What elements of Video could best explain research in a visualization? Nodes in Forest Network, Mycorrhiza network.

**Abstraction Slide** **Answers**: why use physical trees in node network? Not needed, dots can be trees. Size of dot could tell age, color could show different species, closeness could show distance.

\*\*Don’t give corrected report sheet to students til they have completed the activity. Tell them to save for April to refer to for their report.

FYI:

\*\*Actual Bibliography for Susan Similard was 83 entries long. 1995-2016

TED talk Script

A forest is a complex system. Trees provide Oxygen and take in Carbon Dioxide. They turn sunlight into sugars that makes food for the tree to grow. It’s roots take up water to quench the tree. The other trees loose their leaves and they fall to the forest floor. Decomposers take that dead matter and break it down to create food/minerals for producers and consumers. The decomposers live in symbiosis with the plants, the producers. Trees are the foundation of forests, underground there is another world, a world of infinite biological pathways that connect trees and allow them to communicate and allow the forest to behave as though it's a single organism.

Scientists discovered in vitro that one pine seedling root could transmit carbon to another pine seedling root. Does this happen in real forests?

Trees in real forests might also share information below ground. Is the underground the network in the forest? Simard, S.W., Nicholson, A. in1990grew 80 replicates of three species: paper birch, Douglas fir, and western red cedar. They postulated that the birch and the fir would be connected in a below ground web, but not the cedar. They used Radioactive carbon-14 carbon dioxide gas and pressurized stable isotope carbon-13 carbon dioxide gas. They injected the bags with a tracer isotope carbon dioxide gas injected carbon-14, the radioactive gas, into the bag of birch. And then for fir, they injected the stable isotope carbon-13 carbon dioxide gas. They used two isotopes, because they wondered whether there was two-way communication going on between these species.  They waited an hour for the trees to suck up the CO2 through photosynthesis, turn it into sugars, send it down into their roots, and hypothesized, shuttle that carbon belowground to their neighbors. After the hour was up, they ran a Geiger counter over its leaves. It was radioactive so the birch had taken up the radioactive gas. When they pulled off the bag from the fir tree they found it was radioactive. The birch was talking to fir, and because we had shaded the fir. I went up to cedar, and I ran the Geiger counter over its leaves, and as I suspected, silence. Cedar was in its own world. It was not connected into the web interlinking birch and fir.

They checked all 80 replicates. The evidence was clear. The C-13 and C-14 was showing me that paper birch and Douglas fir were in a lively two-way conversation. It turns out at that time of the year, in the summer, that birch was sending more carbon to fir than fir was sending back to birch, especially when the fir was shaded. And then in later experiments, we found the opposite,that fir was sending more carbon to birch than birch was sending to fir, and this was because the fir was still growing while the birch was leafless. So it turns out the two species were interdependent.

And we had found solid evidence of this massive belowground communications network, the other world.

and ask really good questions. And then we've got to gather our data and then go verify.

 How were paper birch and Douglas fir communicating? Well, it turns out they were conversing not only in the language of carbon but also nitrogen and phosphorus and water and defense signals and allele chemicals and hormones -- information. And you know, I have to tell you, before me, scientists had thought that this belowground mutualistic symbiosis called a mycorrhiza was involved. Mycorrhiza literally means "fungus root." You see their reproductive organs when you walk through the forest. They're the mushrooms. The mushrooms, though, are just the tip of the iceberg,because coming out of those stems are fungal threads that form a mycelium, and that mycelium infects and colonizes the roots of all the trees and plants. And where the fungal cells interact with the root cells,there's a trade of carbon for nutrients, and that fungus gets those nutrients by growing through the soil and coating every soil particle. The web is so dense that there can be hundreds of kilometers of mycelium under a single footstep. And not only that, that mycelium connects different individuals in the forest, individuals not only of the same species but between species, like birch and fir, and it works kind of like the Internet.

Mycorrhizal networks have nodes and links. We made this map by examining the short sequences of DNA of every tree and every fungal individual in a patch of Douglas fir forest. In this picture, the circles represent the Douglas fir, or the nodes, and the lines represent the interlinking fungal highways, or the links. The biggest, darkest nodes are the busiest nodes. We call those hub trees, or more fondly, mother trees, because it turns out that those hub trees nurture their young, the ones growing in the understory. And if you can see those yellow dots, those are the young seedlings that have established within the network of the old mother trees. In a single forest, a mother tree can be connected to hundreds of other trees. And using our isotope tracers, we have found that mother trees will send their excess carbon through the mycorrhizal network to the understory seedlings, and we've associated this with increased seedling survival by four times.

We wondered, could Douglas fir recognize its own kin? To answer that question, we grew mother trees with kin and stranger's seedlings. And it turns out they do recognize their kin. Mother trees colonize their kin with bigger mycorrhizal networks. They send them more carbon below ground. They even reduce their own root competition to make elbow room for their kids. When mother trees are injured or dying, they also send messages of wisdom on to the next generation of seedlings. So we've used isotope tracing to trace carbon moving from an injured mother tree down her trunk into the mycorrhizal network and into her neighboring seedlings, not only carbon but also defense signals. And these two compounds have increased the resistance of those seedlings to future stresses.

Through back and forth interactions, they increase the resilience of the whole community.

Forests aren't simply collections of trees, they're complex systems with hubs and networks that overlap and connect trees and allow them to communicate, and they provide avenues for feedbacks and adaptation, and this makes the forest resilient. That's because there are many hub trees and many overlapping networks. But they're also vulnerable, vulnerable not only to natural disturbances like bark beetles that preferentially attack big old trees but high-grade logging and clear-cut logging. You see, you can take out one or two hub trees, but there comes a tipping point,because hub trees are not unlike rivets in an airplane. You can take out one or two and the plane still flies, but you take out one too many, or maybe that one holding on the wings, and the whole system collapses.