Mount Rainier Institute

Final Report

Task Agreement No. P12AC10608
Cooperative Agreement No. H8Wo7110001

University of Washington, School of Environmental & Forest Science

December 30th 2014

Table of Contents

Work Plan

1 Project Summary

In its first year MRI served 364 participants over the course of 6.5 weeks in the fall and 282 over 7 weeks in the spring of 2016-a total of 646. Twelve different schools participated. 10 of the 12 schools were public, one was a parent homeschool partnership with a public school district, and one was private. Eighty-six percent of the participants were from public schools. Because we are a residential program where students are here for multiple days, a better measure of impact is "participant-days" (i.e. one person at MRI for one day is one participant day). There were 2150 participant days in MRI's first year.

Sixty percent of participants were from Pierce County (31% from Tacoma School District). Seventeen percent King County, 12% Yakima County, and 11% Benton County.

An estimated 61% of the traditional public school students reached qualified for free and reduced lunches (WA State average is 46% in 2013). If the parent homeschool partnership is included, the average is 56%. Additionally, participating students came from schools where an average of 50% of student body were students of color. If we look only at traditional public schools, 53% of the student body were students of color compared to the statewide average of 41%. In short, MRI was successful in serving students from diverse ethnic, cultural and economic backgrounds.

2 Implementation

2.1 Implementation Plan Summary

Implementation Plan-Work completed in FY2013

6/25/12 Hire Program Director-***Complete with the hire of John Hayes in September 2012.***

6/25/12 Establish Planning Team to consist of representatives from NPS, Pack Forest, and other UW individuals as appropriate.-***Completed in November of 2012.***

6/30/12 Schedule initial meeting of planning team. –***Completed in November 2012***.

6/15/12 Develop strategy for completing implementation plan. Assign tasks to planning team members.-***Completed in January 2013***

10/1/12 Draft Implementation/Business Plan (first draft complete)-***Completed in January 2013***

12/30/12 Complete Implementation Plan-***Completed in January 2013***

Subject to the availability of funding, additional work will proceed on:

Curriculum Development

1/1/13 Initiate curriculum development in coordination with implementation plan. Initiated in December 2012. ***Though the curriculum development is an ongoing process the first curriculum was completed in Fall 2013.***

1/1/13 If using students to develop curriculum, begin planning for course offerings at UW Tacoma in 2013.-Developed plans for an EE Fellowship program. ***It was determined that in the first year the EE Fellowship program would not be directly connected with UW Tacoma.***

1/1/13 If using students to teach, begin planning for fall 2014 launch of Institute. ***Completed with Launch in Fall 2014.***

3/1/13 Conduct outreach for Institute-***In the spring of 2013 focus groups were conducted. This effort was the beginning of the Institute outreach efforts. Outreach efforts are ongoing.***

3/1/13 Establish governance structure for Mount Rainier Institute. A proposal for a governance structure was incorporated into the Institute business plan. ***NPS and UW share responsibility of governance and oversight of MRI.***

9/30/13 Complete website and development of outreach materials.- ***Initial website was developed in the summer of 2013 and then updated in February 2014.***

Continue Curriculum Development and Preparations to Initiate Institute

11/1/13 Continue curriculum development-***Initial curriculum development was completed in September 2013. The curriculum was piloted with two school groups in October 2013. Further refinement is on-going.***

11/1/13 Begin outreach to schools and logistical preparations (i.e., transportation) –***Outreach to schools began in Spring of 2013 as part of focus group efforts. Twelve Schools were successfully recruited for the first year of programs.***

1/1/14 Begin accepting registrations/participant enrollment.-***Registrations began in January 2014 and are ongoing.***

1/1/14 Start hiring instructors and identifying students who will participate-Job descriptions for Institute positions were completed in December 2013. ***Eight staff were hired for the Fall 2014 season including 1 coordinator, and 7 seasonal instructors.***

Work to be completed in FY2014

5/27/14 Conduct a third spring pilot program-***Lakota Middle School participated in a pilot program in May 2014.***

6/30/14 Complete hiring of instructors and identifying students who will participate- ***Eight staff were hired for the Fall 2014 season including 1 coordinator, and 7 seasonal instructors.***

8/31/14 Complete administrative ramp up to initiate the Institute-***All administrative structure was completed prior to launch. This include the receipt of a grant for $35,000 to support MRI start up.***

8/31/14 Complete registrations/participant enrollment-***Fall season participants were completed.***

8/31/14 Initiate EE Fellows training-***Training was completed in early September 2014.***

9/15/14 Complete Curriculum Development; Mount Rainier Institute opens-***First program began on September 15th, 2014.***

9/30/14 Complete Final Report (summary of implementation plan and curriculum development)

2.2 Curriculum

The interdisciplinary curriculum integrates science, math, and social studies to illustrate the various benefits nature provides humans and the complexity of managing and making decisions about how best to sustainably use those resources. Students explore the various ways humans interact with the environment. For example, students learn about resources like timber harvesting and the value of sustainable forestry. They also explore the inspirational and recreational benefits nature provides humans, and they learn about the ecological benefits such as erosion and pollution control. Throughout this exploration, students develop science process skills through field investigations and student projects (see appendix 4.7 for full curriculum). The objectives of the MRI Curriculum are:

1. To improve students' scientific and environmental literacy using place-base examples;
2. To help students understand their role as stewards of the Mount Rainier region and their home community;
3. To provide students with an understanding and appreciation of public lands such as Mount Rainier National Park;
4. To develop students' connection to nature and the environment;
5. To foster a sense of community among students through shared outdoor experiences.

MRI believes a stronger curriculum can only develop through experience and meaningful collaboration between the institute's educators and the students and teachers they serve. The evaluation process along with the teacher communications were designed to aid in the continuous evolution of the program.

2.3 Audience

MRI's audience is 4-12th grade students with an emphasis on upper middle schools students. Upper middle school is emphasized for two reasons. First, most other residential programs focus on upper elementary school students, and therefore middles school students represent an underserved age group. Second, middle school students are at a crucial developmental stage where the impact of a program like MRI may have a significant impact on future career and/or life choices. In addition, MRI will focused on students that are not already participating in such programs and

are under-represented in the fields of environmental conservation, science, resource management and related fields. Typically these are students of color and are often from urban areas. The schools listed in *Table 1 appendix 4.1* represent diverse ethnic, cultural and economic backgrounds.

Though middle school students are the priority, programs will be created in a way that they are adaptable for both upper elementary and high school aged students. Doing this dramatically expands the potential market and makes it possible for MRI to have multiple points of contact with the same student.

3 Project Evaluation

Trying to do effective evaluation work in our first season proved to be extremely difficult because of a lack of staff capacity and a limited pool of resources. Nonetheless, an evaluation strategy was implemented and yielded baseline results that can be used moving forward.

MRI used a mixed method approach combining pre and post surveys along with focus group interviews to measure the effectiveness of the program. Evaluation instruments were administered to a sample of students and teachers at different times throughout the experience including pre-visit, immediate post-visit, and follow-up post-visit (8 to 10 weeks after the program). Survey instruments were designed to measure progress toward the stated program objectives. Where possible, MRI evaluators looked to modify existing instruments found in EE evaluation literature.

1. ***To improve students' scientific and environmental literac***y. Existing instruments such as those created by the National Environmental Literacy Assessment project (McBeth, William, Volk, Trudi L., 2010) were customized to measure environmental literacy changes after participating in MRI programs.
2. ***To help students understand their role as stewards of the Mount Rainier region and their home community***; survey questions measured students' knowledge of the concept of stewardship and their desire to be stewards.
3. ***To provide students with an understanding and appreciation of public lands such as Mount Rainier National Park;*** questions explored students' general knowledge of the role of National Parks system in society.
4. **To develop students' connection to nature and the environment**; survey questions will measure students' comfort in the outdoors, and attitudes toward the environment.
5. **To foster a sense of community among students through shared outdoor experiences;** questions will explore students' feeling of community while at the Mount Rainier Institute.

3.1 Goal 1-Serve nearly 1000 students in residential programs in the first year.

In its first year MRI served 364 participants over the course of 6.5 weeks in the fall and 282 over 7 weeks in the spring of 2016-a total of 646. Twelve different schools participated. 10 of the 12 schools were public, one was a parent homeschool partnership with a public school district, and one was private. Eighty-six percent of the participants were from public schools. Because we are a residential program where students are here for multiple days, a better measure of impact is "participant-days" (i.e. one person at MRI for one day is one participant day). There were 2150 participant days in MRI's first year.
Sixty percent of participants were from Pierce County (31% from Tacoma School District). Seventeen percent King County, 12% Yakima County, and 11% Benton County.

An estimated 61% of the traditional public school students reached qualified for free and reduced lunches (WA State average is 46% in 2013). If the parent homeschool partnership is included, the average is 56%. Additionally, participating students came from schools where an average of 50% of student body were students of color. If we look only at traditional public schools, 53% of the student body were students of color compared to the statewide average of 41%. In short, MRI was successful in serving students from diverse ethnic, cultural and economic backgrounds.

There were several schools that expressed strong interest in coming but ultimately were not able to. Lakota Middle School in Federal Way, and Glacier View Jr. High in Puyallup, First Creek Middle School in Tacoma, and Royal Middle School in Royal City, all dropped out for various financial, administrative, and planning reasons. Similarly, several

schools that did attend brought fewer students than originally planned. MRI estimates that an additional 300 participants could have been served if these schools were able to attend. Work continues to reach these schools and to help them overcome barriers, and several are scheduled and actively working to make a trip possible in the 2015-2016 school year.

3.2 Goal 2-Conduct programs that have meaningful impacts on students

MRI used pre and post surveys to measure program impact. Surveys were given to students in the latter half of the spring season. Each of the survey questions were aimed at measuring progress towards one of the five stated program goals. Overall, pre and post survey comparisons showed evidence of positive changes in scientific and environmental literacy, sense of stewardship, understanding and appreciation of national parks, connection to nature, and sense of community.

3.2.1 Scientific and environmental literacy

Students were asked knowledge-based questions each worth one point. The mean knowledge score pre-MRI was 1.92 out of a possible 7. Students' scores increased to 3.92 after the MRI experience.

There were 6 questions related to students' enthusiasm for science and learning. When combined, there was an average 7% increase in positive responses. For example, the percentage of students that said they liked learning about science increased by 8%. Similarly, the number of students that indicated they were *not* interested in a career in science decreased by 14%.

3.2.2 Sense of Stewardship

A series of 6 questions were related to students' sense of stewardship. When combined there was an average 4% increase in students responding positively (either agree or strongly agree). For example, the percentage of students that said they are careful not to waste food increased by 10% after the MRI program.

3.2.3 Understanding and appreciation of national parks

63% of the students surveyed had their first experience with a national park through the MRI program. The number of students indicating they thought national parks were important increased by 12%.

3.2.4 Connection to nature and the environment

A series of 7 questions were related to student's attitudes toward nature. When combined there was an average 8% increase in students responding positively to these questions. For example, the percentage of students that said they liked learning about nature increased by 12% after the MRI program.

3.2.5 Sense of community

The percentage of students that thought students in their class got along well increased by 9% after the MRI program.

Though there were several limitations with this evaluation, it allowed MRI to explore program impacts, and provided an opportunity to test evaluation strategies. We look forward to using this information to further refine the curriculum and the evaluation strategies.

3.3 Goal 3-Develop strong collaborative relationships with participating schools

Participating teachers completed a survey at the end of the school year capture their insights on the impact of the program. In some cases, teachers completed this survey several months after their visit to MRI. This give us a sense of the impact on the classroom throughout the school year. Overall results of the survey were extremely positive. Results of the survey are summarized below.

Teachers were asked several questions about the collaborative experience with MRI. 93% of respondents either agreed or strongly agreed that MRI collaborated well with their school. The remaining 7% were neutral possibly

because they were not the lead teacher involved with the organization of the trip. Results were similar when teachers were asked if they felt like they were partners with MRI (88% agreed or strongly agreed), and if they were planning on coming back to MRI (94% agreed or strongly agreed). Additionally, 93% agreed or strongly agreed when asked if they successfully integrated the experience into their classroom, and 94% believed the experience aligned well with learning objectives at their school. Everyone (100%) agree MRI staff were helpful in organizing the trip. Specifically, 67% and 77% agreed that MRI staff helped with communicating with parents and communicating administrators respectively.

Teachers were asked to rate on a scale of 1 to 5 (5 being the highest) how well MRI met the stated program goals. The average ratings were: Science literacy-4.0; environmental literacy-4.39; connection to nature-4.83; understanding and appreciation of national parks-4.56; sense of community-4.39. Likewise teachers responded that the MRI program had the greatest positive impact on students overall comfort and connection to nature, followed by social/community growth, appreciation for national parks, science inquiry skills, observation skills, and interest in taking actions to conserve and improve the environment. The most important curriculum components were the science field investigations, and science symposiums.

Not surprisingly, lack of funding was the most significant challenge teachers faced. A distant second was that students have other commitments such as sports, jobs, etc., that made it difficult for them to be away for multiple days. Lack of principal/administrative support was the least significant challenge.

3.4 Challenges

The most significant challenges MRI encountered were related to school recruitment and their ability to commit to the program. Recruiting schools is a time consuming and difficult process. For example, Lakota Middle School, was a one of the original pilot schools and was identified and recruited in 2013. After a successful pilot program, the teachers were excited about returning in the fall of 2014, and was scheduled. In the early fall the school was still excited to come but was struggling to raise the necessary funds to cover part of the tuition. By the time it was determined that they would not be able come, it was too late to schedule another school which left an empty slot in our calendar. Unfortunately, Lakota was not the only school that happened with. In addition, there were a couple of schools that reduced their number of students significantly which had a similar result.

The “true” cost of the 4-day program is estimated to be over $425 per student. MRI’s top tuition is $280 per student, meaning there is a built in subsidy of $145 per student. In addition schools were offered further tuition assistance based on their need and nearly all the schools took advantage of this opportunity. In most cases this additional tuition assistance was exactly what was need to help schools commit to coming. Still it was important that all schools were able to pay a portion of the tuition. This meant that teachers/schools needed to find ways to generate some funds. Most did this through a combination of parents paying, small fundraisers, and funds from the school district to cover costs beyond the MRI tuition like transportation and substitute charges. MRI staff were actively engaged in helping teachers accomplish this, but the task proved to be too difficult for some.

The work associated with planning an overnight field experience for many schools, especially those that don’t typically do trips like this, is substantial and often left up to the lead teacher. One teacher described it this way:

“When it is only one teacher doing all the work to bring students it is a huge task to accomplish. In addition to everything you have to do to get camp put together you also have to make arrangements for the students that are left at school. There is no compensation for any of the innumerable extra hours it takes to organize and very little recognition of all the time and energy it requires.”

At the same time schools that don’t often take students on these trips are MRI’s target audience. MRI staff will continue to work diligently to shepherd schools and teachers through this process, but there is of course a limit to how much MRI can do. The ongoing challenge will revolve around balancing the needs of our target audiences with

available resources and the need to fill our calendar. It is likely that MRI will need to serve a mix of both schools that can afford the full tuition with those that cannot.

3.5 Teacher Comments

3.5.1 Outcomes & Reflections

- Watching a group of students be challenged with a task they thought to be impossible work together and design a solution to the problem was magical. Those collaboration and problem solving skills will go with them everywhere!
- A few days after returning, we were outside, and Mount Rainier was peaking above the tree line. One of the students -- Alex -- said wistfully, "Every time I see Mount Rainier, it makes me feel good. I guess that's what the Indians must have felt like about the land."
- There were a couple boys I took with me to MRI that several times I caught glimpses of their faces glowing with absolute joy, they were having the time of their lives. Things like that make all the hard work it took to get to camp worthwhile.
- On June 20th a parent of one of our campers text me and sent me a picture of their family at Crater Lake. He said that his daughter will not stop talking about their Mt. Rainier trip and that Crater Lake had a volcano the same as Mt Rainier. She shared how Crater Lake probably looked just like Mt. Rainier a long time ago. That made my day!
- A few students shared that they got to know peers that they wouldn't normally have a chance to know better.
- One of my AP Environmental Science students, standing on the snowy slope of the Nisqually trail, looked around him after the snow density experiment and said "We've been talking, reading and watching movies about Climate Change all year. I really get it now." The experience had a profound experience on him.
- The most amazing comment I heard from my students was during a lesson on the rain shadow effect in class and the student called out "abiatic cooling!". I was amazed that he had connected a short presentation from Mt. Rainier Institute to a major lesson on weather during class. This experience will be forever remembered by these students. The relationships that formed between all of us will last them a lifetime. I have seen increased engagement in class, more attentiveness to lessons/instructions and greater perseverance in critical thinking. Students are genuinely interested in science and how things work - a total change from the beginning of the year. I cannot say enough how much this program has benefited these students. I saw more growth in one month after the trip than I saw the entire school year before the trip. Not only did I see growth in the students, but I also saw growth in myself as a teacher. The connections made with these students helped me to relate to them in a new way and be able to offer them support in their studies that I was not able to before.
- It was a fantastic trip that all the students loved immensely. They loved being able to explore a new area and experience new things with each other. Many students said it was the best field trip they have ever been on.
- Going to Mt. Rainier institute was an amazing way for us to start our year. We normally have a leadership camp without as much environmental education. To have our students immersed in outdoor ed and group initiatives with such wonderful leaders was the high point of the entire year. Our students were challenged and pushed beyond their normal physical limits which forced them to dig deep. We usually have a few students go home from our Bonney Lake camp. No one went home from Mt. Rainier Institute, they did not want to miss any of the activities.
- Mt. Rainier Institute provides South Sound schools an opportunity for high quality environmental education and place - based learning.

3.5.2 Barriers

- I had some challenges with meeting the hurdles of risk assessment. But I have to write, John Hayes was pivotal is talking with the administrators who were slowing up the process for this first year.
- My other challenge was finding chaperons - district policy requires two staff members minimum. So not only am I taking my own time out of a classroom, I'm asking another staff member to sacrifice their class time, even when they may have no students of their own attending.
- The cost was a barrier because of the lack of time to fund raise. We we will be telling families about the camp this summer as we start a new year which will give us 2 years to fund raise. It was difficult to alter two weeks of school. We would have to all go the same week next time in order to not upset the school schedule for two weeks.
- The camp was such a positive experience that any barriers we experienced were well worth the work.
- Trying to convince parents (guardians) to allow our students go for 4 to 5 days was somewhat a challenge.
- District paperwork on top of paperwork for MRI. Nurse sign offs on kids with health challenges.
- Frankly, I think establishing a routine with Mount Rainier Institute -- so administrators, teachers, students, and parents are increasingly familiar with the opportunity and experiences involved -- will continue to alleviate all of these barriers (except the cost for some families).

- When it is only one teacher doing all the work to bring students it is a huge task to accomplish. In addition to everything you have to do to get camp put together you also have to make arrangements for the students that are left at school. There is no compensation for any of the innumerable extra hours it takes to organize and very little recognition of all the time and energy it requires.
- This was our first time as a school and it was so positive experience our administration and parents want us to do it again, but we learned some things. For instance, not to bring extra snacks and food and to encourage younger students not to come without parents (3rd-4th grade).

3.6 Student Reflection

Close your eyes. The ground feels soft beneath your feet. Layers of fungi and moss separate your feet from the rocky mantle of the Earth. Sounds float to your ears. Bird calls abound, as birds find their mates. Wings whoosh as a hawk flies down to catch its meal. The bushes rustle as a small rodent dies out of the hawk's line of sight. You sigh happily. These are the sounds of learning. You open your eyes. You are at the Mt. Rainier Institute, a seemingly learning-infused environment, surrounded by the abounding life of the Trail of the Giants. Now close your eyes again. The ground is impenetrable. Layers of concrete and structural building separate you from the Earth's surface. Scratching pencils on paper awaken your ears to the slight humming of a person's thoughts. The subtle tapping of a person's foot, anxious to succeed. You sigh happily. These are the sounds of learning. You open your eyes. You are at the Mt. Rainier Institute, that gloriously scientifically awakening camp that you are lucky to be able to attend. Surrounded by these happy sensations, learning abounds-and not only in the ways has school acquainted you with. You are able to absorb the haven of life Washington State and its enthralling history is through a series of engaging activities partaken in by both your comrades and teachers. You close your eyes. Learning, experiencing, enjoying, becoming. This is Mt. Rainier Institute. What happiness!

-Rosemary

In response to a Journal Prompt provoking, "What did you take away from Mt. Rainier Institute?"

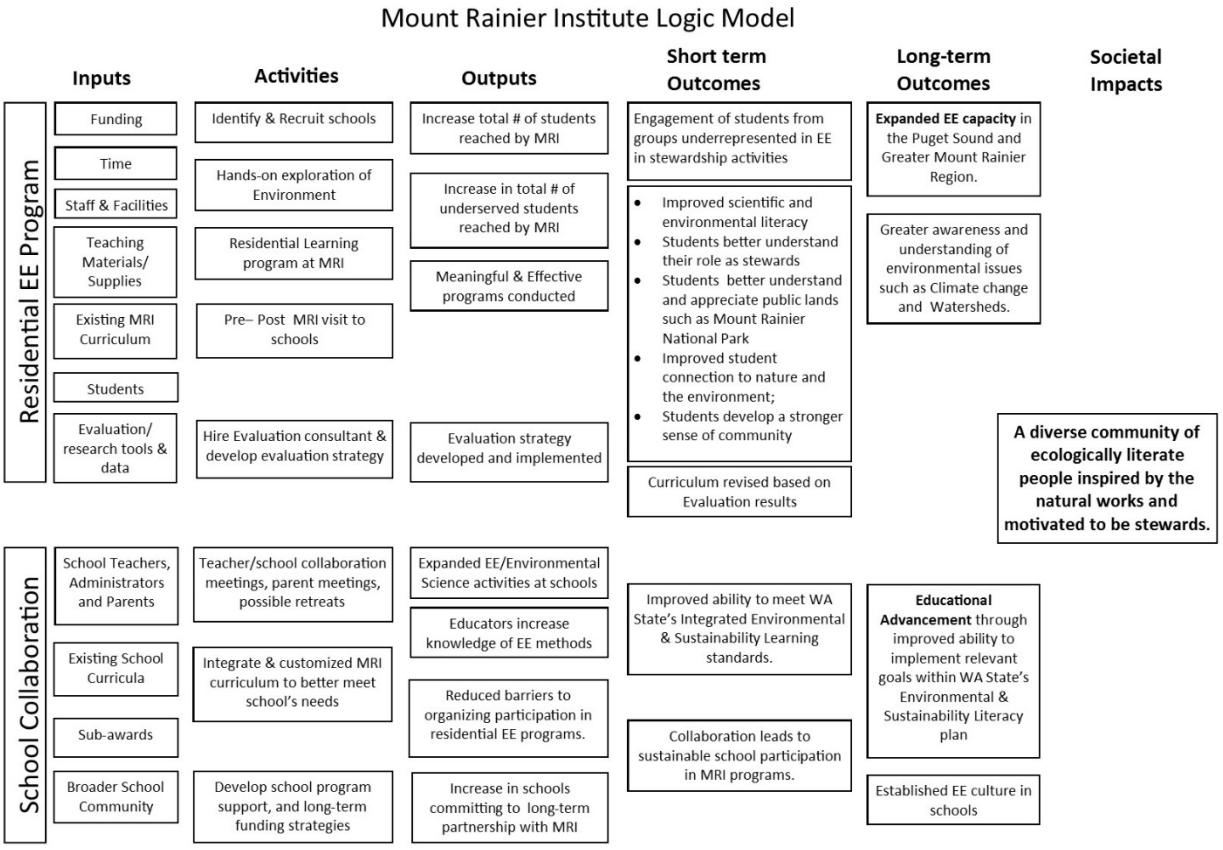
Thank You for a lovely time, Mt. Rainier Institute and its constituent parts!

4 Appendices

4.1 Table 1: Schools Demographics

Table 1		Potential Participating School Demographics											
	Bryant Montessori	Sequoyah Middle School	Wilson Middle School	Jason Lee Middle School	Eatonville	Washington Middle School	Lakes	Highline	Baker Middle School	Madison	TR	CW
	Tacoma School District	Federal Way School District	Yakima School District	Tacoma School District	Eatonville School District	Yakima School District	Clover Park	Highline	Tacoma School District	Seattle	Richland	Private
Total Number of Students	425	555	816	534	262	712	1337		645	766		
American Indian	1%	1%	1%	3%	0%	1%	1%	1%	2%	1%	1%	
Asian	6%	13%	1%	3%	1%	0%	6%	13%	18%	12%	2%	
Black/African American	22%	11%	1%	36%	1%	1%	16%	8%	21%	15%	2%	
Hispanic/Latino	9%	17%	66%	9%	5%	92%	16%	38%	23%	12%	6%	
Pacific Islander	1%	1%	0%	2%	1%	0%	3%	3%	3%	1%	0%	
Two or More Races	3%	11%	3%	2%	5%	1%	11%	9%	1%	7%	1%	
White/Caucasian	57%	45%	28%	45%	81%	6%	48%	27%	31%	51%	88%	
% Eligible for Free & Reduced Lunch	53%	64%	74%	73%	35%	97%	50%	64%	76%	40%	18%	

4.2 Logic Model



4.3 Media Links

Mount Rainier Institute Media Links

Website

http://www.packforest.org/mtrainierinstitute/

Tacoma News Tribune Article

http://www.thenewstribune.com/2014/09/22/3393614_tacoma-kids-are-on-the-hunt-for.html?rh=1

Facebook

https://www.facebook.com/MountRainierInstitute

Video links

https://www.youtube.com/watch?v=9QVgxUIel-Y
https://www.youtube.com/watch?v=_7uysxlBXVk
https://www.youtube.com/watch?v=Evk333snPsU
http://www.schooltube.com/video/8e769eb8c55f4b1ba89e/Mt.%20Rainier
https://www.youtube.com/watch?v=qyEboiTJV-o
https://www.youtube.com/watch?v=iQnz5lxQUpA

Pictures

https://plus.google.com/photos/108278250899410319618/albums/6153661529711340897?authkey=CJjLs8uDg7GBLA
https://plus.google.com/photos/108278250899410319618/albums/6153664000590960801?authkey=CKCs2NrLwLD-uQE
https://plus.google.com/photos/108278250899410319618/albums/6153662752051451505?authkey=CMLw4rrbnemlBA

Tacoma News Tribune Article

Facebook

Video links

Sequoyah Middle School at Mount Rainier Institute

In Their Words 2

In Their Words 1

Three Rivers Home Link at Mount Rainier Institute

Washington Middle School Thank You

https://www.youtube.com/watch?v=iQnz5lxQUpA

Pictures

Pictures 1

Pictures 2

Pictures 3

4.4 Mount Rainier Institute Charter

Vision…

…a diverse community of ecologically-literate people inspired by the natural world and motivated to be stewards.

Mission…

…to provide outstanding nature-based education experiences that are rooted in science and nurture the next generation of environmental stewards and leaders.

Description

In partnership with Mount Rainier National Park, University of Washington is creating the Mount Rainier Institute. Located at Pack Forest, Mount Rainier Institute is a residential environmental learning center that will use the natural and cultural resources of Mount Rainier National Park and Pack Forest to achieve its mission.

Mount Rainier Institute will provide schools in our region with in-depth, multi-day programs focusing on science/STEM education. Mount Rainier Institute would also help connect students and teachers to Mount Rainier National park, and will use the park and Pack Forest as its "classroom." We hope to partner with schools to provide experiences that enhance curriculum, enrich science, and build community.

Students from all backgrounds will have an opportunity to develop their relationship with the environment through a residential experiential education program in a world class location. Being in close proximity to the Puget Sound metropolitan region, Mount Rainier Institute will seek to engage a diversity of students and will target those that normally do not have the opportunity to participate in such programs. Creating a multicultural, scientifically and ecologically literate citizenry that cares about the environment, National Parks and other public lands is essential to an environmentally sustainable future. Programs that foster an appreciation for science and nature, build confidence in being outdoors, connect students to National Parks, and that illuminate potential career paths in the environmental and conservation professions are crucial to this vision.

Values

Community

It is essential to foster a sense of community amongst students, staff, and our partners. Meaningful collaboration with one another will create an enduring conservation ethic.

- We believe in the strength of diversity.
- We respect the values, viewpoints, and beliefs of other cultures.
- We are committed to inclusiveness and seek to engage people of all cultures in the environment.
- We actively work to have a diverse staff and seek to engage a diversity of students.
- We seek to provide programs universally adaptable to *all* people.
- We recognize and encourage others to value the interconnectedness of people, place and issues.

Education

Core to our mission is to help all those involved with Mount Rainier Institute grow and develop knowledge and understanding of the environment.

- We will use our resources to provide the most in-depth, immersive experiences, possible.
- We are committed to facilitating students' and staffs' scientific and ecological literacy.
- We will actively partner with schools and teachers to enhance K-12 science education.
- We will help students understand the importance and significance of Mount Rainer National Park.
- We are committed to inspiring people to become lifelong learners.
- We will provide hands-on authentic learning experiences.
- We will strive to use the environment as the integrating context for all learning.
- We will strive to provide programs that are interdisciplinary and engage a variety of learning styles.
- We will use our resources to provide the most in-depth, immersive experiences, possible.

Excellence

We will strive to bring out the best in people and produces the highest quality experiences possible.

- We are committed working hard.

- We will be accountable to our mission and to all others involved with Mount Rainier Institute.
- We will incorporate the most accurate, up-to-date and best-known science and information into the topics we teach.
- We will hold ourselves and our students to the highest standards of integrity and professionalism.
- We will strive to be a national model for place-based residential environmental education programs.

Place

We will strive to express the value of the Mount Rainier region.

- We strive to be sustainable in our approach to learning.
- We recognize that we must balance the need to engage students in authentic hands-on experiences with the need to preserve and protect sensitive resources.
- We will demonstrate sustainable living practices to the best of our ability.
- We encourage students to develop strong attachments to the Mount Rainier region and connect their experience at
- Mount Rainier Institute in a way that helps them develop an attachment to *their* immediate home.

Inspiration

We believe it is essential to not only educate but also to inspire people to appreciate the joy and beauty of nature, and to become active stewards.

- We will foster hope and help students see the possibilities for a sustainable future.
- We will inspire students to consider careers in natural resource management, education, or related fields.

4.5 Mount Rainier Institute program overview

Mount Rainier Institute provides outstanding nature-based education experiences that are rooted in science and nurture the next generation of environmental stewards and leaders In Partnership with the National Park Service, Mount Rainier Institute uses the natural and cultural resources of Mount Rainier National Park and University of Washington's Pack Forest to help students learn and to develop their relationship with the environment through an educational adventure they will remember for a lifetime.

Mount Rainier Institute programs aim to provide an appropriate mix between interdisciplinary content with process skills such as observation, inquiry, analysis, and supporting claims with evidence. Mount Rainier Institute educators will work with teachers to better integrate the Mount Rainier Institute experience into their classroom curriculum. Possible focus areas include:

Forest Ecology

Students explore the intricacies and interconnections of forest ecosystems and how humans manage forests for multiple benefits. Mount Rainier Institute's main campus is located at Pack Forest which contains both managed forest ecosystems and outstanding examples of old growth. Students conduct research projects that explore the differences between different aged forests and a variety of plant and animal species interrelationships.

Watershed Ecology

Students learn about aquatic ecosystems and the importance to salmon habitat. Students conduct field investigations that can include: macro-invertebrate studies, water chemistry, and physical characteristics of riparian zones. On a trip to Mount Rainier National Park, students see "where the rivers begin" and learn how water shapes the land.

Earth Sciences

Students explore how fire and ice have shaped the land and with it human history. They discover signs of past geological hazards that have occurred on the slopes of Mount Rainier, and see evidence of the awesome power of glaciers. Students also investigate the relationships between abiotic and biotic factors.

EVENING PROGRAMS:

In addition to choosing a curriculum track for your visit, you will also select your Evening Programs. Current options for these include:

Guest Presenters

Field Science Researchers: Mount Rainier Institute's connection with the National Park Service and University of Washington provides the opportunity to learn directly from scientists doing research in Mount Rainier National Park and Pack Forest. With enough advance notice we may be able to set up a program with a researcher.

EcoSel–Students learn explore what they value about nature through this fun and exciting activity. Student will need to make hard choices about how they would manage natural resources in an auction of resource management plans.

Night Hikes – Students challenge themselves to explore nature at night. In field groups students learn about nocturnal adaptations, how humans adapt to the darkness, and astronomy.

Predator Prey Game–This active game puts students in the roles of herbivores, omnivores, and carnivores. They search through their habitat for the food and water they need, while hunting and being hunted by each other. Students learn about food webs and predator-prey relationships and how challenging it can be to survive in nature.

Values of the Past – Students will be introduced to the human history of the Mount Rainier region by going to a "time warp" party where they meet historical figures and learn how people valued nature in the past.

Opening & Closing Campfire – Sing songs, tell stories and reflect around a campfire. Campfires are a fantastic way to end the day and build community, and are a great way to begin to close the program on the last evening.

PRE-TRIP VISIT

A pre-trip visit by Mount Rainier Institute staff will help to prepare students for the program. Pre-trip visits can begin to engage students academically and get them ready for life at Mount Rainier Institute.

POST-TRIP VISIT

A Post-trip visit is designed to connect the Mount Rainier Institute experience back to their home communities, evaluate the program, and strengthen the connection to school curriculum.

4.5.1 Sample Program Schedule

10:15 Opening 15 min

- Students will get off the bus unload luggage into welcome shelter, and are immediately engaged in an active introduction to Mount Rainier Institute.
- Students will be welcomed to the Mount Rainier Institute and introduced to the staff.

10:30 Orientation-1 hour

- Pass out student journals/workbooks
- Students are introduced to the 1 rule at Mount Rainier Institute – RESPECT
- Students are divided into trial groups for the first time.
- Gear rotation-students get checked for proper gear –rain gear, warm layers, water bottle, backpack, etc.

Chaperones are getting a separate orientation during this time-when both orientations are complete- student are put into cabin groups and have a chance to move luggage to their cabin and meet there chaperones.

12pm Dining Lodge Orientation and Lunch

- Students are introduced to the food waste challenge; students will explain why food should not be wasted.
- At the end of the meal, students will get relevant announcements and get a presentation on the weather from the weather group for that meal.

12:45 After Lunch Energizer 15 min –last minute gear check

Introductory Lesson-Introduction to different land uses

- In field groups students participate in teambuilding activities that emphasize the need to work together.
- Students are taken to various stops where there is an activity to help them explore each land uses or Nature Benefits
    - Recreation (hiking, biking, fishing, hunting, camping)

    - Wildlife habitat restoration/preservation
    - Timber Harvesting/Resource extraction
- Students will be able to identify different benefits of the land and how different uses may interact with each other
- Students are asked "how do we make these choices"-how do they make choices about day to day things?

4:30-5:30 Free time
5:30-6:30 Dinner
6:30- 8:30 pm Evening Program-Historic land uses- Values of the Past-

- Students will be introduced to some of the historical figures associated with Mount Rainier region and will be introduced to different ways of valuing the area and reinforcing the concept of Nature Benefits introduced earlier in the day

DAY 2 (May be switched with Day 3 depending on group size and Mount Rainier conditions)
7:45-Breakfast
8:30 Field science Introduction

- Scientific method
- Each group is then sent out to do a structured inquiry field science investigation.
    - Water quality and salmon restoration related to habitat preservation.
    - Possible salmon monitoring comparisons (what are best nesting sites for salmon, what are habitat characteristics.
    - Old growth diversity study/comparison
    - Carbon sequestration comparison

12pm Lunch
Continue field investigation
3:30 begin to analyze data

4:30-5:30 Free time
5:30-6:30 Dinner
6:30- 8:30 pm Evening –science symposium

DAY 3
7:45-Breakfast
8:30 Depart for MORA
9:15 Arrive at Nisqually gate
9:15 National Park Service and Recreation

- Students learn about the NPS management objectives and understand the mission of NPS.
- Students learn about specific management challenges facing MORA

12pm Lunch
12:30 The power of the mountain

- Students learn about natural processes that have shaped the land.
- Impact of flooding
- Volcanic land forms
- Observe Nisqually glacier and discuss origins of the river and source of fresh water
- Learn about glacial land forms parts of glacier, how glaciers form etc.
- Students find a solo spot given journal prompts to reflect on beauty of area

4:00 Depart for Pack Forest
5:00-6:00 Free time
6:00-7:00 Dinner
7:00- 8:30 Closing campfire/cabin or trial group skits-slide show-Art/music/drama

DAY 4
7:45-Breakfast
8:30 Group Energizers
9:00 Final Hike
Journal time
Solo spot
Trail group debrief
11:00 Closing Ceremonies
11:30 Lunch & Depart

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MOUNT RAINIER INSTITUTE
CURRICULUM

Spring 2015 Final

TABLE OF CONTENTS

INTRODUCTION

In partnership with Mount Rainier National Park, University of Washington has created the Mount Rainier Institute. Located at University of Washington's Pack Forest, Mount Rainier Institute is a multi-day overnight environmental education program that will use the natural and cultural resources of Mount Rainier National Park and Pack Forest to provide outstanding nature-based education experiences that are rooted in science and nurture the next generation of environmental stewards and leaders.

Mount Rainier Institute will provide primarily middle school students a 4-day, 3-night environmental education program. Multi-day overnight environmental education programs are powerful experiences for students. These programs are not only important sources of science education and academic enrichment, but they help students develop positive connections to the environment, foster awareness and appreciation, promote environmental stewardship, and support positive social and community development.

Despite the potential power of residential environmental education, relatively few students in the Washington have the opportunity to experience such important and impactful programs. There are approximately 243,000 public school students in grades 4-12 within a 90 mile radius of Mount Rainier Institute. The Mount Rainier Institute market analysis estimates that far less than 20% of these students will participate in an overnight environmental education program during their K-12 education.

This opportunity gap is particularly evident in the economically disadvantaged areas and multicultural communities in the south Puget Sound. The establishment of Mount Rainier Institute center will 1) enhance the environmental education capacity in the region; 2) serve as a catalyst to advance environmental literacy in schools, 3) train future environmental educators; and 4) expose students to potential career paths in environmental sciences, National Parks, and other related fields. The Mount Rainier Institute has the potential to reach thousands of kids annually and seeks to narrow the opportunity gap in overnight environmental education program participation by specifically targeting underserved audiences in the south Puget Sound and greater Mount Rainier region.

MISSION

Mount Rainier Institute provides outstanding nature-based education experiences that are rooted in science and nurture the next generation of environmental stewards and leaders.

VISION

A diverse community of ecologically-literate people inspired by the natural world and motivated to be stewards.

VALUES

Community

It is essential to foster a sense of community amongst students, staff, and our partners. Meaningful collaboration with one another is the only way to create an enduring conservation ethic.

- We believe in the strength of diversity.
- We respect the values, viewpoints, and beliefs of other cultures.
- We are committed to inclusiveness and seek to engage people of all cultures in the environment.
- We actively work to have a diverse staff and seek to engage a diversity of students.
- We seek to provide programs that are designed to be universally adaptable to all people.
- We recognize and encourage others to value the interconnectedness of people, place, and issues.

Education

Core to our mission is to help all those involved with Mount Rainier Institute grow and develop knowledge and understanding of the environment.

- We are committed to facilitating students' and staffs' scientific and ecological literacy.
- We will actively partner with schools and teachers to enhance k-12 science education.
- We will help students understand the importance and significance of Mount Rainer National Park.
- We are committed to inspiring people to become lifelong learners.
- We will provide hands-on authentic learning experiences.
- We will strive to use the environment as the integrating context for all learning.
- We will strive to provide programs that are interdisciplinary and engage a variety of learning styles.
- Mount Rainier Institute will provide information that is unbiased and politically neutral.
- We will use our resources to provide the most in-depth, immersive experiences, possible.

Excellence

We will strive to be organization that brings out the best in people and produces the highest quality experiences possible.

- We are committed to hard work.
- We will be accountable to our mission and to all others involved with Mount Rainier Institute.
- We will incorporate the most accurate, up-to-date and best-known science and information about the topics we teach.
- We will hold ourselves and our students to the highest standards of integrity and professionalism.
- We will strive to be a national model for place-based residential environmental education programs.

The Power of Place

We will strive to express the value of the Mount Rainier region.

- We strive to be sustainable in our approach to learning about the environment.
- We recognize that we must balance the need to engage students in authentic hands-on experiences with the need to preserve and protect sensitive resources.
- We will demonstrate sustainable living practices to the best of our ability.
- We encourage students to develop strong attachments to the Mount Rainier region and connect their experience at Mount Rainier Institute in a way that helps them develop an attachment to their immediate home.

Inspiration

We believe it is essential to not only educate but also to inspire people to appreciate the joy and beauty of nature, and to become active stewards.

- We will foster hope and help students see the possibilities for a sustainable future.
- We will inspire students to consider careers in natural resource management, education, or related fields.
- We will help students rekindle their curiosity and sense of wonder for the natural world.

PROGRAMMATIC GOALS

1. To facilitate students understanding of scientific and ecological literacy. Through hands-on, place-based, interdisciplinary educational activities, programs will provide students with an authentic experience that develops their understanding of the scientific process and ecological concepts.
2. To help students understand their role as stewards of the Mount Rainier region and their home community.
3. To provide students with an understanding and appreciation of the role of Mount Rainier National Park and the National Park Service.
4. To develop a student's own connection to nature and the environment.
5. To foster a sense of community among students through shared experiences outdoors.

This curriculum seeks to align with both Common Core and the Next Generation Science Standards.

CURRICULUM OVERVIEW

Mount Rainier Institute programs aim to provide an appropriate mix between interdisciplinary content with science process skills such as observation, inquiry, analysis, and supporting claims with evidence. Mount Rainier Institute naturalists/instructors will work with teachers to better integrate the Mount Rainier Institute experience into their classroom curriculum.

The curriculum focuses on forest ecology, watershed ecology, and earth sciences. All Mount Rainier Institute instructors should strive to create a positive learning environment for students that is place based, inquiry based, and academically challenging. Because of this, there is extensive background information in each lesson plan. This background information is for instructors and should be taught to students as needed for academic rigor—don't just regurgitate all the background information for every group.

By no means is this curriculum the last word on any of the subjects we teach about. All naturalists/instructors should add their expertise to make this curriculum a living document so that it continues to be relevant, engaging, and inclusive of all students.

Focus Areas

Forest Ecology

Students explore the intricacies and interconnections of forest ecosystems and how humans manage forests for multiple benefits. Pack Forest contains both managed forest ecosystems and outstanding examples of old growth. Students conduct research projects that explore different aged forests and a variety of plant and animal species interrelationships.

Watershed Ecology

Students learn about aquatic ecosystems and the importance of salmon habitat. Students conduct field investigations that can include: macro-invertebrate studies, water chemistry, and physical characteristics of riparian zones. On a trip to Mount Rainier National Park, students see "where the rivers begin" and learn how water shapes the land.

Earth Sciences

Students explore how fire and ice have shaped the land, and with it human history. They discover signs of past geological hazards that have occurred on the slopes of Mount Rainier and see evidence of the awesome power of glaciers. Students also investigate the relationships between abiotic and biotic factors.

Evening Programs

Opening & Closing Campfire

Sing songs, tell stories and reflect around a campfire. Campfires are a fantastic way to end the day and build community, and are a great way to begin to close the program on the last evening.

Values of the Past

Students will be introduced to the human history of the Mount Rainier region by going to a "time warp" party where they meet historical figures and learn how people valued nature in the past.

Predator-Prey Game

This active game puts students in the roles of herbivores, omnivores, and carnivores. They search through their habitat for the food and water they need, while hunting and being hunted by each other. Students learn about food webs and predator-prey relationships and how challenging it can be to survive in nature.

Night Hike
Students challenge themselves to explore nature at night. In field groups students learn about nocturnal adaptations and how humans adapt to the darkness.

Field Science Researchers
Mount Rainier Institute's connection with the National Park Service and University of Washington provides the opportunity to learn directly from scientists doing research in Mount Rainier National Park and Pack Forest. With enough advance notice we may be able to set up a program with a researcher.

EcoSel
Students learn and explore what they value about nature through this fun and exciting activity. Students will need to make hard choices about how they would manage natural resources in an auction of resource management plans.

Pre-Trip Visit
A pre-trip visit by Mount Rainier Institute staff will help to prepare students for the program. Pre-trip visits can begin to engage students academically and get them ready participate in a field study research project.

Post-Trip Visit
A Post-trip visit is designed to connect the Mount Rainier Institute experience back to students' home communities, evaluate the program, and strengthen the connection to school curriculum.

SAMPLE PROGRAM SCHEDULE – 4 days

Day 1	**Welcome and Introduction to Field Science**
11:00	Arrive at Pack Forest, introductions, move into cabins
11:30	Lunch, orientation, chaperone meeting
12:30	Break into trail groups, introduction to field science
5:00	Free time
6:00	Dining hall orientation and dinner
7:00	Evening program - Values of the Past
8:00 - 9:00	Campfire

Day 2	**Pack Forest Field Research**
7:30	Breakfast, gather gear and lunches
8:30	Pack Forest field investigation and data collection, lunch on the trail
5:00	Free time
6:00	Dinner
7:00	Prep for Symposium
Wednesday: 8:00	Large Group Game
Thursday: 8:00	Final Campfire

Day 3	**Mount Rainier National Park**
7:30	Breakfast, gather gear and lunches
8:30	Mount Rainier National Park, lunch on the trail
5:00	Free time
6:00	Dinner
7:00	Trail group time
Wednesday: 8:00	Large Group Game
Thursday: 8:00	Final Campfire

Day 4	**Making Connections / Closing**
7:20	Cabin check-out: instructors will come by. Please sweep & place linens in a pile, check bathrooms & showers for lost and found.
7:30	Breakfast (come to breakfast after gear has been taken to the Pavillion)
8:30	Symposium Prep
9:00	Research Symposium
9:45	Trail time
11:00	Lunch (return all borrowed gear before lunch)
11:50	Group picture
12:00	Departure

SAMPLE PROGRAM SCHEDULE – 3 days

Day 1	**Welcome and Introduction to Field Science**
10:00	Arrive at Pack Forest, team building, orientation, chaperone meeting

11:00 Move into cabins
11:15 Break into trail groups, introduction to field science, Timber Cruise
12:15 Travel to Old Growth, lunch on the trail
12:30 Field investigation & data collection
5:00 - 6:00 Free time
6:00 Dining hall orientation and dinner
7:00 Values of the Past
8:30-9:15 Campfire at the Pavillion

Day 2 Mount Rainier National Park Day
8:00 Breakfast, gather gear and lunches
9:00- 5:00 Travel to Mount Rainier National Park: Longmire and Paradise
Park time may include: snowshoeing & lessons on life zones and snow science
5:00 - 6:00 Free time
5:45 KP report to dining hall (1 from each cabin)
6:00 Dinner
7:00 Prep for symposium
8:30-9:15 Final Campfire at the Pavillion

Day 3 Making Connections / Closing
7:45 Cabin check-out: instructors will come by. Please sweep & place linens in a pile, check bathrooms & showers for lost and found.
8:00 Breakfast (come to breakfast after gear has been taken to the Pavillion)
8:45 Symposium prep
9:15 Research symposium
9:45 Trail time
11:30 Lunch
12:15 Group Picture, return gear
12:30 Departure

DAY 1

The purpose of Day 1 is to help students become comfortable in a new place while starting to use their senses to explore Pack Forest and being introduced to the theme of Nature's Benefits. This day serves as an introduction to research, scientific tools, making observations and asking questions, and working with their trail group and instructor.

Goals:
- Students will feel welcomed and be in a safe, positive learning environment.
- Students will get an introduction to sustainable forestry, ecology, and how Pack Forest and Mount Rainier National Park are managed differently.
- Students will be introduced to Nature's Benfits.
- Students will use teamwork to complete teambuilding challenges, games, and activities with their trail group.

ARRIVAL AND ORIENTATION

At a Glance

Grade Level(s): 3rd-12th

Time Required: 60 minutes

Location: Welcome Shelter or Field

Materials Needed:
- Any teambuilding materials (balls, ropes, etc) needed for group energizers
- Student cabin assignments (ask Education Coordinator or Lead Teacher for this)

Activity Summary: Orientation is led by one or two Instructors. Students will be introduced to their instructors and the other adults involved in the program (including chaperones). As a group we'll talk about the expectations we have for them, including respect and the rule of 3 (buddy system for older students).

Learning Objectives. Students will be able to…
- meet and recognize Mount Rainier Institute staff.
- engage in activities that set an enthusiastic tone for their stay at Mount Rainier Institute.
- understand what they are expected to do and how they are expected to behave at Mount Rainier Institute—respect, rule of 3/buddy system.

Key Words: Respect!

Details

Procedure:

Orientation:

1. Greet students on the bus and tell them what is going to happen immediately after unloading the bus:
    a. Several MRI Instructors will facilitate the unloading of luggage (with help from students and chaperones), which will temporarily be stored under the Welcome Shelter.
    b. Students who need to use the bathroom will be let off first and will follow an instructor over to the bathrooms.
2. Teach students an "attention getter" that they will use for the rest of the week. (Ask first if there's one they use at school so we can be consistent with what they're already used to.)
3. Facilitate luggage unloading while some students are at the bathroom and continue encouraging students to gather in the field when they are done/come back.

4. Once everyone has gathered in the field, introduce yourself and welcome the group again. Tell the group that all the adults (MRI staff, chaperones, and teachers) will introduce themselves by saying their name, where they're from, and a couple interesting facts (ex. their favorite thing to do in nature, what they really geek out about, favorite song).
5. After introductions, send the chaperones to the adult orientation with the Education Coordinator and lead 1-2 active group games to get the students moving (see Appendix C for a list of activity ideas).
6. After the game(s), students will remain with the Instructors in the field/welcome shelter/campfire circle for the student orientation. Here they are introduced to the expectations at Mount Rainier Institute.
7. Tell students that our main rule here is Respect, and asks students to discuss in small groups ways they can be respectful during their time at Mount Rainier Institute.
8. Give students about five minutes to talk in small groups, then ask them to share with everyone. Ensure that students understand that our rule of respect includes respecting others, themselves, the environment and our surroundings.
9. Go over the consequences (i.e. the discipline policy) if the respect and rule-of-3 expectations are not followed.
10. Write: SHURBEJAN on a large easel and explain ((sit pad, hydration, utensil for writing, raingear, backpack, empty bladder, journal, additional layer(s), nametag). Students should have each of these items with them each day.
11. When teachers and chaperones return, explain the cabin move-in process. Students and their cabin chaperone will be dismissed to gather their luggage and take it to their cabin. Emphasize that this is not the time for them to unpack. They simply need to drop their luggage in their cabins, get any SHURBEJAN gear they may have packed in their luggage, use the bathroom, wash hands, and come back to the Welcome Shelter ready for the field day. Ideally this will take no more than 15 minutes. Make sure to give the students and chaperones a specific time to be back in the field.
12. Break into trail groups and have lunch.

Pre-Trail Time:

1. At the close of orientation each instructor will read off their trail group list. Once in their trail groups, Instructors will have time to play a name game, introduce other introductory teambuilding activities (see Appendix C for ideas), and start figuring out what gear students need to borrow. It is important to set a positive tone for your trail group and outline specific trail group goals and expectations for the week. One idea for this is to create a trail group contract.
2. Instructors should pass out journals, nametags, and sit pads, and go over the essential items needed each day and why they are important. Students should have brought their daypack ready to go, but might need to get something or leave something in their cabins in order to be fully prepared for the day.
3. Review SHURBEJAN (sit pad, hydration, utensil for writing, raingear, backpack, empty bladder, journal, additional layer(s), nametag) with students and check that they have each of these things, plus anything else you think necessary. If students don't have everything they need the instructor should make a note of it and check items out in the Equipment Room.

Learning Context: This is the first large group session and should set the tone for the rest of the week.

Possible Extensions:

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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Lesson: Nature's Benefits Exploration

Objectives

Students will be introduced to the concept of Nature's Benefits

Estimated Time & Location

15 minutes. In the Ball Field area or other large group meeting area.

Materials

Blank Cards (about 20 for each trail group)
Clipboards (1 for each trail group)

Background

The following description of Natures Benefits is modified from a description of ecosystem services taken from the Millennium Ecosystem Assessment Synthesis
Report. http://www.millenniumassessment.org//en/Products.Synthesis.aspx

Ecosystem services are the benefits people obtain from ecosystems. The Millennium Ecosystem Assessment Synthesis Report describes four categories of services. These include provisioning, regulating, supporting and cultural services. For Mount Rainier Institute purposes we will structure our exploration of ecosystem services or "Nature's Benefits" into three categories; cultural, economic, and ecological. Below are some examples.

Cultural Benefits. These are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. Recreation *are types of cultural benefits.* People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.

Cultural diversity. The diversity of ecosystems is one factor influencing the diversity of cultures.

Spiritual and religious values. Many religions attach spiritual and religious values to ecosystems or their components.

Knowledge systems (traditional and formal). Ecosystems influence the types of knowledge systems developed by different cultures.

Educational values. Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.

Inspiration. Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture, and advertising.

Aesthetic values. Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations.

Social relations. Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.

Sense of place. Many people value the sense of place that is associated with recognized features of their environment, including aspects of the ecosystem.

Cultural heritage values. Many societies place high value on the maintenance of either historically important landscapes (cultural landscapes) or culturally significant species.

Recreation and ecotourism. People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area

Economic Benefits-These are the products obtained from ecosystems including:

Food. This includes the vast range of food products derived from plants, animals, and microbes.

Fiber. Materials included here are wood, jute, cotton, hemp, silk, and wool.
Fuel. Wood, dung, and other biological materials serve as sources of energy.
Genetic resources. This includes the genes and genetic information used for animal and plant breeding and biotechnology.
Biochemicals, natural medicines, and pharmaceuticals. Many medicines, biocides, food additives such as alginates, and biological materials are derived from ecosystems.
Ornamental resources. Animal and plant products, such as skins, shells, and flowers, are used as ornaments, and whole plants are used for landscaping and ornaments.
Fresh water. People obtain fresh water from ecosystems and thus the supply of fresh water can be considered a provisioning service. Fresh water in rivers is also a source of energy. Because water is required for other life to exist, however, it could also be considered a supporting service.

Ecological Benefits- These are benefits obtained from the regulation of ecosystem processes. Some examples of Ecological Benefits include:
Air quality regulation. Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality.
Climate regulation. Ecosystems influence climate both locally and globally. At a local scale, for example, changes in land cover can affect both temperature and precipitation. At the global scale, ecosystems play an important role in climate by either sequestering or emitting greenhouse gases.
Water regulation. The timing and magnitude of runoff, flooding, and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.
Erosion regulation. Vegetative cover plays an important role in soil retention and the prevention of landslides.
Water purification and waste treatment. Ecosystems can be a source of impurities (for instance, in fresh water) but also can help filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems and can assimilate and detoxify compounds through soil and subsoil processes.
Disease regulation. Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.
Pest regulation. Ecosystem changes affect the prevalence of crop and livestock pests and diseases.
Pollination. Ecosystem changes affect the distribution, abundance, and effectiveness of pollinators.
Natural hazard regulation. The presence of coastal ecosystems such as mangroves and coral reefs can reduce the damage caused by hurricanes and large waves.

At MRI we will guide our students through an exploration of these three types of Nature's Benefits. It is important for instructors to remember that the intent of investigating these different categories is to provide a framework for understanding all the ways humans benefit from nature. The reason for using this framework is not necessarily so that a student can define what a cultural benefit is. Rather, it is so that they can better understand the various demands humans (or they) put on ecosystems and that we must be mindful about our resource management decisions.

Procedure

1. Students are divided into trail groups.
2. Show students the large map of the Mount Rainer Region. Point out where Pack Forest is. Do they see where Mount Rainier National Park is? Explain that over the next couple of days, they will have a chance to explore these two amazing natural places-Pack Forest and Mount Rainier National Park. Students will see that there are many similarities…but there are also some differences. For example Pack Forest is a

"Working Forest." What do you think a "working forest" is? On the other hand Mount Rainier is a National Park. Each of these places provide us with very important things. In fact nature provides us humans with all sorts of benefits, and that is what we want to begin to explore today. Let's start by thinking about the different ways humans benefit from nature. Have students begin to brainstorm how they think they benefit from nature.

3. Explain that there are stacks of cards are in the center. In a moment we will give the signal to start and you trail group will need to try and write down as many different "nature benefits" as they can. The rules are simple. Only one student at a time may run out to get a card. They may only bring back one card at a time. The group then decides one benefit to write on that card. When the card is complete, the next student can run out and grab a card. Keep going until the whistle blows. The goal is to get as many different things as they can on the cards in the amount of time provided
4. Blow the whistle and start the relay. Give students enough time so that each student gets a chance to run out and grab a card. Note: Trail leaders will need to coach students into how they think about this. Try to be respectful of student thinking but start getting them to think in terms of categories. For example if a student says "food" than that should count for all food and students should not just start listing apples, bananas, nuts, etc.
5. Stop the relay by blowing a whistle. Go around and have each group read from one of the cards, not repeating what another group has already stated until all ideas have been shared.
6. Collect the cards into ziplock bags labeled "cultural benefits", "economic benefits", and "ecological benefits". As the day continues, encourage students to add additional benefit examples to the bags.

TIMBER CRUISE (Economic Benefits)

At a Glance

Grade Level(s): 6th-8th

Time Required: 30-45 minutes

Materials Needed:
- Selection of tree-sourced products (cellophane, nail polish, paper, maple syrup…)
- DBH tapes - 2
- Clinometers - 2
- Tariff Tables - 2+
- Volume tables - 2 +
- Calculator - 1
- Board Foot - 1
- Student journal - 1 per student

Activity Summary: While students conduct a mini timber cruise on a trail in Pack Forest, they will identify species of trees, volumes of timber, and estimated monetary value. Students work in small groups to collect data and calculate the estimated timber value.

Learning Objectives. Students will be able to…
- Students will know how to use basic forestry measurement tools including a DBH Tape and a clinometer.
- Students will understand the concept of using trees for economic benefits.
- Students will understand the difference between renewable and nonrenewable resources.

Key Words: Clinometer, DBH Tape, Tariff, Renewable Resource, Nonrenewable Resource, Board Foot, Timber Cruise, Forester/forestry

Details

Background:

One big way humans benefit from trees is as economic resources (also known as Forestry Resources). Here in Washington we're situated in one of the best places in the world to grow trees. A timber inventory (or, timber cruise) is conducted by Foresters to estimate the volume of merchantable material in an area and to determine the density and species of the trees growing in the area. Foresters use the information they get from their timber cruise to estimate the number of board feet the trees they cut down will render.

To perform a timber cruise you need to measure the diameter of the tree (using the DBH tape) and the height of the tree (using with clinometer). You can then find the number of board feet for that tree using the Tariff and Volume tables.

History of Pack Forest

Pack Forest is a “working forest.” This means that it is being actively logged, and has been since the mid-1920s. The reason that you don’t see many clear cut areas in this forest is because the foresters here use sustainable logging techniques. Pack Forest was designated in 1925 by Charles Pack when he sold the land to the University of Washington to use as a teaching forest. Charles Pack understood both the benefits of trees as well as those of logging and wanted a place where people could learn how to log sustainably.

1920s
Correspondence begins between Charles Lathrop Pack (via his son Captain Arthur Newton Pack) and the University of Washington to establish a "show window of forestry." This demonstration forest would provide a place where the public and forest owners could learn about scientific forest management practices. The forest would also serve as a field location for College of Forestry (now School of Environmental and Forest Sciences) students to learn forestry field skills, and as a site to conduct forest related research. UW Board of Regents purchases 334 acres of land from Northern Pacific Railroad and the Cascade Timber Corporation along the Mount Rainier Highway. Trails and cabins are built. Construction begins on a shingle and saw mill. A forest nursery is developed growing Douglas-fir, western red-cedar, Port Orford cedar, ponderosa pine and western hemlock. Research projects mark the beginning of field research at Pack.
1930s
Pack Forest's total land base grows to 2,104 acres. Construction finishes on shingle and sawmill and provides lumber and shingles for Pack Forest buildings and UW campus buildings. With the Great Depression in full swing, President Franklin D. Roosevelt initiates the Civilian Conservation Corps work relief program; Pack Forest becomes "C.C.C. Pack Forest Camp S223." C.C.C. workers build the reservoir dam at a junction between two branches of 27 Creek (an earth-filled cribbed type with a 2.5 million gallon capacity and creosoted wooden pipes to convey water to points of use), fell snags, build roads, trails, Pack Hall, and start an arboretum with stock form the College of Forestry nursery on campus.
The Works Progress Administration (W.P.A.), provides workers to build student and instructor residence cabins and houses, dining hall, a classroom, the garage and machine shop, a warehouse, shower house, and an insectary. The men cut, transport, and mill all the lumber used in their building projects.
1970s
Legislative cutbacks virtually eliminate services and programming at Pack Forest. The summer academic field study program is reinstated. Biosolids ("sludge") research on land application begin to study the effects of using reclaimed solid waste from wastewater treatment plants as a source of nitrogen fertilizer. Land base now 2,880 acres as a result of minor land acquisitions (including 607-acre "Flying M Ranch," or Murphy's Ranch.
1980s
New classrooms, dormitories, restrooms, and water and sewer systems are built; large stimulus had been provided by research funding. By 1982, three additional acquisitions are made, including 1,046 acres from the Weyerhaeuser Company. The total size of Pack Forest is now 4,073 acres. Pack Forest begins collecting and testing weekly rainwater samples as part of the National Atmospheric Deposition Program. A permanent weather station is installed and monitored by Pack Forest.
1990s

The Pack Forest land base now grows to 4,374 acres. The forest is considered "fully developed" with forty miles of permanent roads and eight miles of developed and maintained trails, consisting of a combined 15 miles of self-guided and interpretive hikes and walks. Educational outreach becomes an important focus at Pack Forest.
2000s
The Center for Sustainable Forestry at Pack Forest is created. Spring Quarter Field Studies end at Pack Forest.
2009: The College of Forest Resources joins the College of the Environment as the School of Forest Resources.

Determining Tree Height

*NOTE: Make sure the clinometer you're using has this set of numbers/letters on the front: PM-5/360PC. If it says anything different, the following steps won't work because it's calibrated and set up differently. In that case, please refer to the owner's manual (which can be found online) specific to the one you're using.

There are two ways to calculate the height of a tree. One method requires a few more calculations, while the other requires you to stand 100 ft away from the tree being measured. Something to remember is: due to human error, your calculation won't be the *exact* height of the tree, though it will be pretty close. Both of these methods should get you within 3-4 feet of the actual height of the tree.

More Math:

1. Measure out any distance from the base of the tree. Stay on flat ground and make sure you can see the top of the tree from where you stop. To get the most accurate reading possible, stand with your toes behind the line of where you measured to (ex: if you measured 75 ft, stand with your toes behind the 75 ft line) so that when you hold the clinometer up to your eye it will be directly over the foot marker.
2. With both eyes open, look through the clinometer and line up the black line with the top of the tree. Read the number on the right-hand side of the scale. Then look at the base of the tree through the clinometer and, again, read the number on the right-hand side. The number from the base of the tree will be a negative number (which is noted on the number scale but it might not be obvious at first glance). The number from the top of the tree will be positive.
3. Subtract the number at the base from the number at the top. (Ex: number from top of tree is 83, number from base of tree is -4. So, 83- -4 becomes 83+4, which = 87.)
4. Take that number and multiply it by the distance you are from the tree. Then divide that number by 100 to get the height of your tree in feet. (Ex: Using the examples from above, 87 x 75 ft = 6,525. Then 6,525/100 = 65¼ ft tall.) *Note*: if the tree is taller than 150 ft you'll be off the scale for the clinometer so either call it at 150 ft or estimate how much taller it is. It'll also be off the scale for the volume and tariff tables, so for that part of the activity you'll have to round down.

Less Math:

1. Measure out 100 feet from the base of the tree. Make sure you can see the top of the tree from where you're standing. To get the most accurate reading possible, stand with your toes behind the 100-ft line so that when you hold the clinometer up to your eye it will be directly over the 100-ft marker.
2. With both eyes open, look through the clinometer and line up the black line with the top of the tree. Read the number on the right-hand side of the scale. Then look at the base of the tree through the clinometer and, again, read the number on the right-hand side. The number from the base of the tree will be a negative number (which is noted on the number scale but it might not be obvious at first glance). The number from the top of the tree will be positive.

3. Subtract the number at the base from the number at the top to get the height of your tree in feet. (Ex: number from top of tree is 67, number from base of tree is -5. So, 67- -5 becomes 67+5, which = 72. Therefore, your tree is 72 ft tall.) *Note*: if the tree is taller than 150 ft you'll be off the scale for the clinometer so either call it at 150 ft or estimate how much taller it is. It'll also be off the scale for the volume and tariff tables, so for that part of the activity you'll have to round down.

The reason this works without multiplying by the distance and then dividing by 100 is: because you're 100 feet from the tree you would be multiplying by 100 and then divide by 100, which would bring you back to your starting measurement.

Determining Tree Volume

Volume is a 3-dimensional value, so the object's area and depth or height need to be known (this could also be related as its width, length, and height). Trees are cone-shaped, or tapered cylinders. To calculate the volume of a tree, its height and diameter at both the bottom and the top need to be known.
Doing a brief online search yielded very complex equations for finding the volume of a tree, so it's recommended that you use the volume table. However, if you want to learn more about calculating tree volume, the most readable resource is the National Forest Assessments Knowledge Reference
paper: http://www.fao.org/forestry/17109/en/

Procedure:

1. Show students a series of items from your "tree products" bag. Ask them to think about what all of these things have in common (one item will be a board foot of timber). If they're not getting it, you can point out that they are all made from trees. We use wood products every day and because of that trees are a very important benefit that Washington forests provide us.
2. Introduce the idea of Pack Forest being a working forest. What does that mean? What do Foresters do? (They help to make decisions about how to manage forests in order to provide a sustainable source of Forest Products or other services forests provide.) One service, or benefit, that we commonly think of is timber.
3. Tell students that they are now going to become foresters and actually "cruise" some timber. Explain that they are going to be involved in a process to inventory the volume of trees in an area of a stand at Pack Forest that can be made into forest products such as lumber. This is what Foresters call a "timber cruise."
4. Show students the "board foot" example and explain that the board foot is the standard unit of volume measurement for timber resources in the U.S. When conducting a timber cruise, Foresters try to determine how many board feet of timber are in each tree to be sold and ultimately how many board feet are in the forest stand to be cut.
5. Most foresters use volume tables to make their work quick and easy. You only need to know the diameter and the height of the tree. We will use two forestry tools—a DBH tape and a clinometer to measure the diameter and height, then use the tables to determine the volume. You can discuss with your students how they think volume is determined and what shape a tree is (cone or tapered cylinder).
6. Demonstrate the use of the DBH tape and the clinometer.
7. Divide students into groups of 3-4 people. Have each group pick a tree (the one they think might be the most valuable). They now "own" that tree. Have at least one student in each group act as a recorder so all of the measurements get recorded in their journals.
8. Hand out tools and have each group measure the diameter and height of their tree.

9. Once everyone has measured their tree, gather up and explain how to use the volume tables to determine how many board feet of timber there is in their tree.
10. Once they have determined how many board feet are in their tree, ask them to determine how much their tree is worth in timber. (Timber prices per board foot are in the student journal.)
11. Add up the value of everyone's trees. How much would one acre of the forest be worth? How much is a 10 acre stand worth?
12. Ask the following questions as part of the wrap up: Does that seem like a lot of money? How do we (as humans) benefit from timber resources? What is the "cost" of cutting timber? In other words, what other services might we give up so that we might have timber? Do you think it is worth it?

Learning Context: This is a day 1 activity, but can be done in any order with the Cultural and Ecological Benefits of Trees lessons. The Instructor may have to provide more context or background information depending on where in the day this lesson falls.

Possible Extensions:

- Older students may actually try and determine the volume using a formula if you are comfortable enough with math to find and facilitate that.
- You can incorporate the "Washington Forestry Facts" cards as discussion prompts or simply as facts that students read out loud.

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

LICHEN ACTIVITY (Ecological Benefits)

At a Glance

Grade Level(s):

Time Required: 40 minutes

Materials Needed:
- Small marking flags (10 of 1 color for each student group, numbered 1-10)
- Envelopes to store flags
- Masking tape
- Erasable felt-tip markers
- Lichen grid transparencies (master included)
- Lengths of string
- Compasses

Activity Summary:

In this lesson, students conduct a short tree ring analysis as a way to learn about how trees help improve air quality and removal/regulation of pollution by examining lichens. This activity is modified from several sources including:

The Concord Consortium
http://staff.concord.org/~btinker/gaiamatters/investigations/lichens/classactivities.html
Air and Waste Management Association-Don't take a lichen to Pollution

Learning Objectives. Students will be able to…
- Students will be able to recognize three different kinds of lichens.
- Students will understand how to measure lichen coverage using grids.
- Students will be introduced to the scientific process

Vocab Words:

Details

Background:

Ecological benefits are the benefits that we get from the regulation of natural ecosystem processes.

From “Don’t take a Lichen to Pollution”-Lichens (pronounced *likens)* look like plants but are really two types of plants, fungi and algae, growing so closely together that they look like single organisms. Scientists still do not fully understand the relationship between the fungi and algae that make up lichens. They are often considered symbiotic organisms-mutually beneficial to each other. The photosynthesizing algae provide food for both, while the fungi appear to provide moisture, minerals, and support. However, lichen fungi cannot live without their algae partners, while most of the algae can live by themselves. This may mean that the fungi are parasites, using the algae to obtain food and giving little to the algae in return.

Whatever the relationship between the algae and fungi, it is a highly successful one. Lichens often grow in locations where most other plants cannot-bare rocks, tree trunks, bare soil. In some of these locations they play an important role helping soil formation. By interacting with the bare rocks to help break them down chemically and by trapping dust and organic matter from the air, lichens often start to create and enrich soil where other plants can eventually grow. Every natural habitat from deserts to rain forests has lichens. They-are able to survive extreme conditions heat, cold, and drought. However, few species of lichens can survive air pollution, particularly acid air pollution.

Lichens come in a variety of sizes, shapes, colors, and textures. Lichens are often divided into three classifications-crusty, leaf-like, or shrubby. Crusty lichens usually grow flat on rock, sand, tree trunks, and may be embedded in these surfaces. Crusty rock lichens are colorful and range from oranges and yellows to greens, browns, grays, and blacks. Leaf-like lichens have lobed surfaces that are only partially attached to other surfaces. Shrubby lichens are branched and either stand upright or hang from other surfaces. Leaf-like and shrubby lichens are usually some shade of green. Lichens are often confused with moss, but real mosses are tiny plants with leaves and stems. Because lichens were once mistakenly classified with mosses, some common lichens were named Reindeer moss, Oak moss, and Iceland moss.

Lichens are extremely sensitive to air pollution and can sometimes be used as indicators of air quality. Scientists study both the type of lichens present and the size of the lichens. Shrubby and leaf-like lichens can only survive in clean air. Lichens are relatively rare in large cities; in areas of very heavy air pollution there are no lichens of any type. The size of the lichens present is also important. Larger individual lichens generally mean better air quality. In 1971 an air quality map of the British Isles was made based on an evaluation of lichen presence and growth.

Lichens are also valuable for evaluating air quality in another way. Lichens accumulate metals and other elements from rainwater and dust. By analyzing lichens that live near emission sources for chemicals which indicate pollution, scientists can determine how far the pollution has spread.”

Procedure:

1. Play a quick observation game. Show students a fruticose lichen and have them find it. Do the same with foliose, and crustose. Ask students what they think they are.
2. Explain that these are lichen, and share the background information with the students. Lichen actually represent another really important benefit that nature and especially forests provide. Air quality and pollution control. Explain why lichens are used as air quality indicators. Distribute copies of the student sheet "LICHENS AS POLLUTION INDICATORS". Explain how the types and amounts of lichens present are used to measure air quality.
3. Explain to the students that they are now going to become scientists. Together they are going try and answer the question: What is the air quality in Pack Forest? Have students develop a hypothesis for what they think.

4. Show students how we will determine air quality using lichens. Distribute transparencies of the "LICHEN GRID". Demonstrate how to use the lichen grid and how to count the number of circles the lichen covers.
5. Each team of 3, with a lichen grid, chooses one tree to study.
6. Once each team has chosen a tree to measure, have them tie a string around their tree at 4.5 feet off the ground.
7. Use a compass to determine North, South, East and West. Mark the string with a permanent maker.
8. At each of the 4 directions at **BH** (4.5 feet from the ground), place the transparency grid against the tree.
9. Students count each square where lichen is present and record the data in their journals.
10. For each tree, find the average lichen coverage by totaling the lichens found within the circles, and then dividing the total by 4 (for each direction). Note the lichen type if possible.
    Average Lichen Coverage for survey plot: _____ %
11. Discuss the results with the students: What kinds of lichens were found? How do you think air quality might be affected if there was a timber harvest? We often take these kinds of ecological benefits for granted. Can you think of other services like pollution control that nature provides us?

Learning Context:

Possible Extensions:

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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CULTURAL BENEFITS

At a Glance

Grade Level(s): 6th-8th

Time Required: 30 minutes

Activity Summary:

Materials Needed:
- Cultural Benefits Poetry Task Card
- Examples of Nature Photography
- Nature Poetry Example

Learning Objectives. Students will be able to…
- Students will be introduced to the idea of Cultural Benefits while immersed in nature on a Pack Forest trail.
- Through guided prompts, students will create an original poem or work of art.

Key Words:

Details

Background:

Cultural Benefits are the non-material benefits that people gain from natural ecosystems.

Procedure:

1. Hike to a beautiful part of the forest. Show students examples of Nature Art such as nature photos, paintings, sketches, writing, etc.
2. Ask students what Nature "provided" that made these works of art possible? Nature provides us beauty and inspiration. Explain that cultural benefits are non-material benefits that people gain from natural places such as this.
3. Read an excerpt from the Edward Carpenter poem, and pass out the poetry task card.
4. Ask students to write a poem about this place-they can use the poem structures or freestyle.
5. Sit Spot: next find a comfortable place to sit amongst the beauty of Pack Forest and write.
6. After 20 minutes, gather the group together and ask for volunteers to share their writings.

Learning Context:

Possible Extensions:

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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PACK FOREST DAY

The purpose of the Pack Forest day (either day 2 or 3) is for students to continue to hone their observation and questioning skills. Students will build on what they learned on Day 1 to gain a deeper depth of knowledge for their study topic.

Goals:

- Students will continue exploring and getting to know the Pack Forest ecosystem.
- Students will create and complete a scientific field study with guidance from their instructor.
- Students will use teamwork to complete teambuilding challenges, games, and activities with their trail group.

REVIEW OF SCIENTIFIC PROCESS

At a Glance

Grade Level(s): 5th-10th

Time Required: 30 minutes

Materials Needed:
- Scientific process cards (one set of cards per group)

Activity Summary: An instructor will introduce the scientific method using the scientific process cards. The students will compete in small groups to figure out the order of the scientific process. Bonus points if they arrange the cards in a circle instead of a line.

Learning Objectives. Students will be able to…
- describe each step of the scientific process.
- understand that the scientific process is a circular, rather than a linear, process and that you can complete steps out of order.

Key Words: Scientific Process. Hypothesis.

Details

Background:

The majority of our students should have already learned the scientific process (also called scientific method) in school, so this should be a review activity. Be ready, however, to explain the steps and help groups get them in the right order if they haven't learned it yet or don't remember it. It is important for all students to have a solid understanding of the scientific process before beginning their field study.

Procedure:

1. As students come into Pack Hall (or wherever you do this activity) show them where to sit. Each small group will have a different area of the room, hopefully around a table.
2. Explain that today all the students are going to be scientists and that each trail group will be completing a field study, from start to finish.
3. Tell students this activity will be a review of the scientific process, to get their brains into science mode so they're ready for the day.

4. Explain that each group has an incomplete set of cards showing the steps in the scientific process and that their goal is to retrieve the missing steps so they can complete the process and put all the steps in order.
5. To trade a card with another group, one student per group can go into the Trading Zone (a spot in the middle of the room marked off by a table or a hula hoop they have to stand in, etc) and do a blind trade with another student. Make sure to emphasize that only one student per group is allowed in the trading zone at a time and they can bring only one card at a time. Both cards being traded must be held face down during the trade and the students can't turn them face up until they get back to their group.
6. Once a group thinks they have all the steps and have put them in the correct order, they can raise their hands and ask an instructor to check their work. The instructor can work with the students to help them fix any mistakes and to hint at organizing the cards into a circle.
7. Once all groups are finished, talk about why the steps are in this order as well as why scientists sometimes move back and forth between steps instead of completing them all in order.
8. Check for understanding and answer any questions students have about the scientific process and their field study.

Learning Context: This is usually done on the morning of the Pack Forest day (either day 2 or 3) and serves as an introduction to the research the students will be doing that day.

Possible Extensions:

Adaptations for different learning needs:

· This activity can be done in the classroom as part of a pre-visit for younger students or students who need more help learning the scientific process.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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FIELD STUDY

At a Glance

Grade Level(s): 5th-10th

Time Required: 5-7 hours

Materials Needed:
- Whiteboard & dry erase markers
- Student journals & pencils
- Field guides
- *Specific tools will vary*

Activity Summary: During this inquiry-based lesson, each trail group comes up with a research question, figures out the materials they need, decide on their methods (procedures), and collect data. This lesson is an all-day experience.

Learning Objectives. Students will be able to…
- Students will apply what they know about the scientific process in order to come up with a research question, hypothesis, materials, and methods for data collection.
- Students will practice using scientific tools to collect data.
- Students will be able to modify their materials and methods, if needed, to collect sufficient data.

Key Words:
- *General*: scientific process, scientist, field study
- *Study* area: transect, plot
- *Tools*: DBH tape, measuring tape, quadrat, clinometer, densiometer, thermometer, field guildes, foxtail

Details

Background:

Introduction to Inquiry-based Field Science

It can be daunting to facilitate an inquiry-based field study simply because it's hard to plan for something you're not controlling. Being comfortable with not knowing what direction the students will go with their questioning and feeling confident about helping them come up with a research project that fits within the time and material parameters takes practice. This Introduction to Inquiry-based Field Science is intended to set you up for success as you begin learning how to facilitate open inquiry discussions.

When having your students come up with their own research question, it's very important for you to know the scope of the study—realistically, what will you have time for, where will you be, and what tools will you have available. Remember that the students haven't been here before. They won't always know much about the landscape or how to use it or the tools to their advantage when forming their question.

Help set your students (and you) up for success by driving home that this needs to be a simple project. Make sure you teach them about the different tools they can use before you ask them to think about potential research questions. And when you teach them how to use the tools, ask them to come up with an idea of something you could study with just that tool. This will help them when they try to figure out a research question.

A Note on Terminology

We do "field studies," not "experiments." An experiment has a variable that you're testing or manipulating and a control to compare it to. What we do in the field is not an experiment, it's "field science," a "field study," or "field research." Sometimes we look at multiple variables and since we're outside in nature we have no control over the landscape that we're "testing."

Use the word "elevation" rather than "altitude." Elevation refers to a distance above sea level to which humans can walk, while altitude refers to the distance above sea level where airplanes fly.

A "transect" is not synonymous with "study plot." A transect refers to a specific type of plot that is long and often requires you to move along it as you collect data. For example, a path along which you would walk and count/record occurrences of the species you're studying.

You can't "prove" a hypothesis. A hypothesis is an educated guess that is analyzed based on your data. It can't be proven and it can't be "right" or "wrong." Your data either will either support it or not support it. Both outcomes are valid and both should lead you to further questioning about your research topic.

Student Expectations for Field Study

All students will be going outdoors together and collecting data in forested terrain. The terrain is often off trail and may be uneven. They will:

- Work respectfully within their assigned groups (3 groups of 3 or 4 students per group depending on trail group size).
- Stay within the boundaries described by their field instructor
- Use equipment only as instructed
- Wear appropriate clothing for an outdoor investigation

Procedure:

OBSERVATIONS & PRIOR KNOWLEDGE

1. Since this is probably the students' first time in this particular area, give them some time (at least 10 minutes, and maybe even 30 minutes to 1 hour) to look around, explore, and make observations. This will greatly help the process of coming up with a research question. (See Appendix XX for a list of potential observation activities.)
2. Once they have had time to make observations and get familiar with the area, call them back and ask each student to share one of their observations. Write these on your whiteboard as they are said—this gives students a visual. If they are really excited and want to share more, go around the circle a second time or ask students to raise their hand if they have another observation they want to share.
3. Ask students what they already know about the area, based on their observations or their prior knowledge of trees, geology, etc. Write these on your whiteboard as they are said.

RESEARCH QUESTION & HYPOTHESIS

1. Decide, based on the level of your group and any time constraints, whether you're going to facilitate the students coming up with their own research question (*student-led inquiry* or *open inquiry*) or if you're going to guide the topic of their question (*guided inquiry*) or even come up with the question for them (*instructor-led inquiry, structured inquiry*).
2. Ask students to think of questions they have about the area. These questions will probably (and should) be influenced by their observations and things they were taught earlier in the program.
3. For open and guided inquiry, remind students that the scope of their research question should be something they can complete using the tools and materials they have access to, and in the time allotted. In other words, simple. Write the questions on your whiteboard.
4. Once there is a good list of questions, ask students which ones are outside the scope of their project. Let them point out the questions that are too big, require tools/materials they don't have access to, or could be answered by doing research in a book or on the computer. Cross these off or make sure they're recorded elsewhere if you're going to erase them—they can come into play after the research when students are thinking of further questions.
5. After the students have gone through the list of questions, look it over and cross out any others you think are outside the scope of the project. Explain why you're taking them off the list.
6. Have the students vote or have a discussion about the remaining questions, and pick one to research.
7. Once the research question is set, have students write it in their journals. Now you can move on to creating the hypothesis.
8. There are two main formats for writing a hypothesis—"I think ____, because _____" and "If ____, then ___, because _____." You can ask the students what they use at school, give them the options and let them decide which one to use, or tell them how you would like them to structure their hypothesis. "I think…" tends to work

the best for the kind of research we do, but some teachers/students are really invested in structuring it as "If…then…" so that's something to be ready for.

9. When having your students form their hypothesis, you can either have each of them independently write their own hypothesis, or you can have them come up with one as a group. If you're letting them each come up with their own hypothesis, tell them that they will have a few minutes to think about it and write it down. Tell them that this is a quiet, independent activity and not a time to talk as a group.
10. If your students each wrote their own hypothesis, have some of them share it with the group once everyone has it written down. Ask if anyone else has a similar hypothesis, or if anyone has a different hypothesis.

MATERIALS & METHODS

1. Ask a student to read the research question aloud. Tell students to think about how they could go about gathering data in answer to this question and what materials they would need to do that.
2. As students share the materials they will need, list them on your whiteboard and write down what each material/tool is used for—Ex: DBH tape, to measure the diameter of trees. Have students write this down in their journals.
3. If anything is missing, encourage them to think of more materials or add to the list. If the group is doing a visual count of something (for example, the number of snags within 10 feet of the trail) it is up to you whether putting "eyes" on the materials list is important.
4. Once all the materials are listed out and copied into students' journals, move onto creating your method (or procedure).
5. Quickly reiterate the research question and materials and remind the students that their method needs to be written clearly and with step-by-step instructions so that someone else could come after them and repeat it exactly the same way.
6. Ask for one step at a time, and write them in a numbered list on your whiteboard. Have students copy the steps in their journals.
7. Remind students that when they begin collecting data they will need to write down everything—data specific to their question and methods, as well as other general observations about the data collection sites—things that might come into play later when they think about their limitations or other things that may have affected their data.

DATA COLLECTION

1. Divide your students into smaller groups to collect data on different things. For example, if you're going to be collecting data on tree diameter and canopy density, have some students measure DBH and other students take canopy cover readings. That way each student had a job to do and you can collect more data without it taking way too much time.
2. Choose, or have the students choose, one person per group to be the data recorder. This person should keep their journal and pencil out, while the rest of the students can put theirs away.
3. Keep an eye on the small groups while students are collecting data. Some students won't want to write anything down, some will get off task, and some will need help. If you can put a trustworthy chaperone with one group that's great too.
4. If a tool isn't working as well as anticipated or if the students want to change something or they're not coming up with the data they thought they would be, remind them that this is part of science. Remind them that they can write it down as a potential limitation, or they can go back and change their methods if they need to. Emphasize that they need to write down any changes they make to their methods and record any observations of things that might be affecting their data in ways that weren't accounted for earlier.

Learning Context: Make sure all students have a solid understanding of the scientific process before going into the field to do this study.

Possible Extensions:

Adaptations for different learning needs:
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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):
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MOUNT RAINIER DAY

The purpose of the Mount Rainier day (either day 2 or 3) is to introduce students to life zones, volcanology, the importance and history of Mount Rainier National Park and the National Park Service, and to explore an area under different land management than Pack Forest. Locations typically include Nisqually Vista Trail at Paradise and/or Trail of the Shadows at Longmire.

Goals:

- Students will understand why national parks are important and why Mount Rainier National Park exists.
- Students will be able to describe the natural processes (volcanology, adiabatic cooling, etc) that they learn about.
- Students will use teamwork to complete teambuilding challenges, games, and activities with their trail group

INTRO TO NATIONAL PARKS

At a Glance

Grade Level(s): 6th-8th

Time Required: 15-20 minutes

Materials Needed:
- Laminated NPS arrowhead
- White board (optional)

Activity Summary: This is mostly a visual/auditory activity where students learn about the history of the National Park Service, the importance of national parks, and why Mount Rainier National Park exists. There are opportunities for students to participate by answering questions posed by the instructor.

Learning Objectives. Students will be able to…
- Explain the purpose of the National Park Service logo and elaborate on the symbols in the logo.
- Understand the importance of the National Park Service mission.
- Understand the value of Mount Rainier National Park and their role in its preservation.

Vocab Words: Preservation. Protection. Unimpaired.

Details

Background:

The National Park Service was established in 1916. The mission of the National Park Service is "to conserve the scenery and the natural and historic objects and the wildlife therein in such a manner as will leave them unimpaired for the enjoyment of future generations." The logo of the National Park Service represents this mission. The tree (a sequoia tree) and the bison symbolizes the mountain and vegetation and the wildlife protected by the park service. The shape the lake represent scenic and recreational value. The arrowhead Service (all represents cultural resources preserved by the National Park resources). cultural resources, not always Native American cultural

The first national park to be established was Yellowstone National Park, in 1872. This was before the National Park Service was established. Before the National Park Service was established, many of the National Parks were run and managed by a branch of the military. There was no single unifying agency to

manage the national parks before the National Park Service was established. Today, we have 401 national parks nationwide. These national park sites take on many forms: National Parks, National Historic Sites, National Lakeshores, National Monuments, and many more. Although all of these places are very different, they are all still protected underneath the National Park Service mission. National Parks are owned by the people of the United States, and it is our responsibility to support their preservation.

Mount Rainier National Park was established in 1899, the 5th national park to be established in the United States. Mount Rainier National Park (MORA) is comprised of 236,381 acres, or 369 square miles. This is about 4.5 times the size of the city of Seattle. 97% of MORA is officially designated as wilderness. It may seem that this should be an easy hands-off management plan for the Park Service, but employees of MORA must carefully manage the land in the park in order to ensure its protection as a wilderness area. About 1.5-2 million people visit MORA each year. In 2014, MORA had about 1.8 million visitors (that's about 3 times the population of Seattle). Mount Rainier stands 14,410 feet above sea level, and is the tallest point in Washington State. Each year, approximately 10,000 people attempt to summit Mount Rainier, and slightly less than half succeed (usually due to weather). Mount Rainier is the second snowiest place in the world (in terms of places where precipitation is measured), second to Mount Baker, which is also part of the Cascade Mountain Range in Washington.

Procedure:

1. Show the NPS arrowhead to students. Ask if they have seen this symbol before, and ask if the students know what it is.
2. Explain that the arrowhead is the logo of the National Park Service. Explain that the logo has a lot of meaning, and everything on the logo symbolizes something that is important to the National Park Service. Ask students to call out different things that they see on the logo.
3. As students call out things that they see, ask them to guess what these things symbolize. Explain that the tree represents vegetation, the bison represents wildlife, the mountain represents scenery and recreation, the lake represents scenery, recreation, and natural resources, and the arrowhead shape represents cultural resources. Make sure that students understand that cultural resources do absolutely include Native American history, but can also include many other aspects of cultural history in the United States.
4. Explain how the NPS arrowhead relates to the mission of the Park Service. The mission of the NPS is to preserve and protect all of the things on the logo in order to leave them unimpaired for the enjoyment of future generations.
5. Ask students to provide examples of how the NPS fulfills this mission, and ask them to provide examples of how they can help fulfill this mission. (Ex: stay on the trails to preserve the scenery so that people in the future can enjoy it too).
6. Describe to students how National Parks can come in many forms. Some are big like MORA, others are tiny (some national monuments are very small). Help students understand that although all of these places can be very different, they are all protected under the same logo and mission of the National Park Service.
7. Help students understand that the National Parks are the property of all people of the United States, and it is our responsibility to support their upkeep and preservation.
8. From here, you may go into a discussion of other fun facts about the National Parks that are listed in the background section of this lesson plan. For some groups, it is good to go into a lot of detail with lots of information, but for others, it is best to just stick with a discussion of the logo and mission. Gauging group interest and ability is important in this decision.

Learning Context: It is best to do this lesson very soon after students get off of the bus in the National Park, in order to provide them with context of where they are, and to understand the place before going on further explorations.

Possible Extensions: It is possible to extend this activity with a sit spot on the Trail of the Shadows. Students are given either a blank sheet of paper or a blank arrowhead. Ask the students to find a quiet place by themselves along the trail. On their paper, they should design their own NPS arrowhead based on their own values. Ask the students to draw what they value about the National Parks, or what things about the National Parks are important to them. This is a nice reflective activity to emphasize the many different values of the NPS, and how the values of National Parks can be different for every person.

Adaptations for different learning needs:

- For students who need more visuals, you can use a whiteboard to write up some key words/ideas for the things you talk about.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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GEOLOGIC PROCESSES AND VOLCANOLOGY

At a Glance

Grade Level(s): 6th-8th

Time Required: 20-30 minutes

Activity Summary: Students learn the basics of plate tectonics and how plate tectonics are responsible for the existence of Mount Rainier through visual, auditory, and kinesthetic methods. Students investigate hazards associated with a volcanic eruption and discover hazards that are most dangerous to human populations.

Materials Needed:

- 2 sit pads
- White board and dry erase markers
- PNW plate tectonics drawing
- Hazard map and overlays
- Lahar sample

Learning Objectives. Students will be able to…

- Understand and recognize plate movement and types of plate boundaries
- Understand subduction zones and the reason Mount Rainier exists
- Recognize hazards associated with a volcanic eruption and their threats to human populations

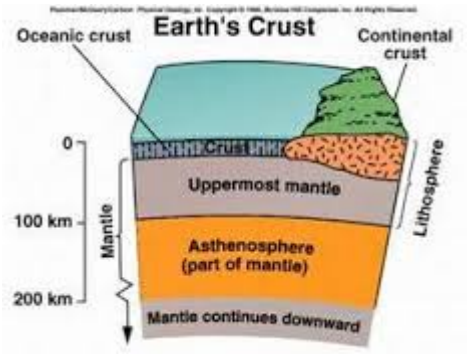
Key Words: plate tectonics, convergent plate boundary, subduction zone, divergent plate boundary, transform plate boundary, volcano, magma, lava, tephra, lahar

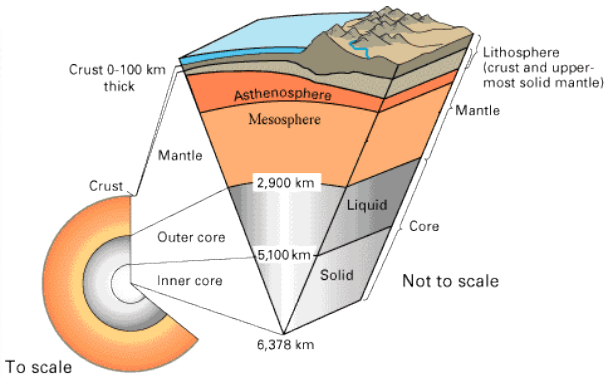
Details

Background:

Plate Tectonics Basics

If you took a giant knife and sliced the Earth in half, you would notice that the Earth has layers. Put simply, these layers are the core, mantle, and crust. The core is comprised of an inner and outer core, and the mantle is comprised of the mesosphere, asthenosphere, and lithosphere. The crust is also technically part of the lithosphere. Tectonic plates are made up of the crust and the very upper mantle, i.e., the lithosphere. These diagrams should clarify this. It is often better to simplify this to just the crust, mantle, and core for the purposes of this lesson.



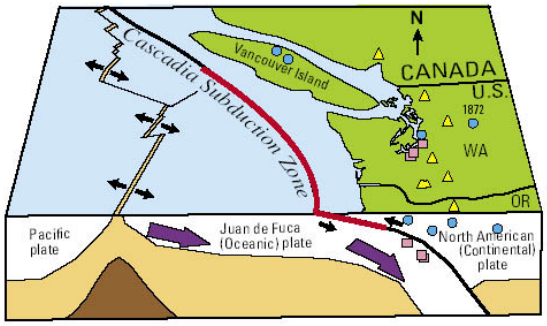


The lithosphere (or the crust, simplified explanation) is not one continuous layer. It is made up of many different pieces, or plates, called **tectonic plates**. You can imagine that the tectonic plates are like cookies floating on top of a giant vat of pudding, the mantle. It is also important to recognize that the mantle is solid, not liquid. Its temperature is hot enough to create molten rock, but it is under so much pressure that it remains solid. (Imagine a mixture of cornstarch and water: when you squeeze this mixture, it is solid, and when you release this pressure, it is liquid. Rocks are the same way.) These tectonic plates move around on top of the mantle, and interact with each other. When plates interact with each other, we call it a **plate boundary**.

There are 3 categories of plate boundaries: **convergent**, **divergent**, and **transform**. **Convergent** boundaries occur when two plates are smashing into each other, and can either result in really intense mountain uplift (like the modern Himalayan mountain range), or a **subduction zone**, where one plate that is denser is forced underneath the less dense plate. A **divergent** plate boundary is one where two plates are moving away from each other (like the middle of the Atlantic Ocean, the North American and South American Plates are moving away from the African and Eurasian Plates). A **transform** plate boundary is where two plates are sliding against each other (like the San Andreas Fault area). The type of faulting that occurs at a transform boundary is called strike-slip faulting, but the plate boundary itself is called a transform boundary.

PNW Plate Tectonics

Off the coast of Western Washington, we have a divergent and a convergent plate boundary. Out in the ocean, the Juan de Fuca Plate and the Pacific Plate are moving away from each other in a divergent boundary. The Juan de Fuca Plate and the North American plate come together in a convergent boundary, a subduction zone in this case.



(image from the USGS)

The Juan de Fuca plate is forced underneath the North American Plate because oceanic crust is much denser than continental crust. As the Juan de Fuca Plate is crushed up against the North American Plate in the ocean, a lot of seawater gets mixed up in the mess. A lot of this water travels down the subduction zone with the Juan de Fuca Plate. As the Juan de Fuca Plate moves down into the mantle, it heats up because temperature increases with depth underneath the surface of the Earth.

At a certain point, the water that has been mixed up into the Juan de Fuca Plate begins to get so hot that it turns to steam, which melts part of the Juan de Fuca Plate. This melt, or **magma**, begins to rise towards the surface of the Earth. It rises because this liquid state is lighter, or less dense, than the surrounding solid rock. Like bubbles in a pot of boiling water, this less dense material travels upwards. This molten magma pools underneath the surface of the Earth in a giant magma chamber, which feeds the volcano—Mount Rainier! As more and more of the Juan de Fuca Plate melts and travels upwards, more and more magma is added to this magma chamber. Eventually, this results in a buildup of so much pressure, that a volcanic eruption results.

Eruptions and Hazards

During an eruption, lots of crazy stuff comes out of the volcano. We will divide this stuff into three general categories: **lava, tephra,** and a hodgepodge of debris material that will feed a **lahar**.
Lava is simply magma that has come up above the surface of the Earth. Molten rock underground is called magma, and molten rock above ground is called lava. Lava generally moves relatively slowly, but can be produced in very large volumes. Lava is not a very big concern to human populations because it moves slowly enough that you could literally walk away from a lava flow, and because it only covers a relatively small area around the point of eruption.
Tephra is magma that explodes out of the volcano with such force that it is dynamited into microscopic bits of ash that float up into the atmosphere and slowly rain down onto the surface of the Earth like snow. Tephra has the potential to travel vast distances in the atmosphere before it rains down onto the surface. It tends to travel with prevailing atmospheric systems, and has the potential to cause respiratory problems in humans if inhaled. It also has the potential to cause fires if it is still hot when it comes back down, generally near the point of eruption.

Chunks of hot rocks and tephra and other debris erupted from the volcano can come together with a source of water to form a boiling hot slurry of debris that moves very rapidly down the slope of a volcano, called a **lahar**. The rocks and debris can range in size from microscopic ash particles to boulders the size of a house. This lahar will flow extremely rapidly down major river channels, and can also travel very long distances depending on the amount of debris and the size of the eruption. Lahars are a huge threat to humans because they move so quickly, and because many large urban areas exist within these historic lahar zones (Puyallup and Tacoma in particular). Folks who live in these areas generally know something about lahar evacuation routes in their neighborhoods.

The good news is that Mount Rainier is monitored very closely for any signs of eruption, and volcanic eruptions tend to be relatively predictable. An eruption is usually preceded by seismic activity (small earthquakes), and/or land deformation (a bulge in the side of the mountain as a result of increased pressure). There are seismic and deformation monitoring stations located all over the mountain. (more info here: https://volcanoes.usgs.gov/volcanoes/mount_rainier/monitoring_summary.html) The likelihood of an eruption without any warning is extremely low.
From Longmire and the Trail of the Shadows, you can view a large andesite lava flow cliff across the valley. This ancient lava flow moved between two large glaciers that completely filled the valley at the time.

Procedure:

Plate Tectonics Basics

1. Instructor explains that the Earth is made up of layers (core, mantle, and crust). This can be done with a drawing on a white board. The instructor then explains that the crust is made up of lots of pieces—tectonic plates—that move on top of the mantle and interact with each other in many different ways.
2. The types of plate boundaries are demonstrated using two sit pads (Convergent—uplift and subduction, divergent, and transform)
3. Students are broken up into two teams and compete to create the best representations of these plate boundaries using movement with their bodies. Students are given about one minute to come up with a plan for each boundary type, and then perform for each other. All group members must be a part of their representation. The instructor or a chaperone may be the judge.

PNW Plate Tectonics

1. PNW Plate tectonics drawing are passed out and shared among students. Instructor asks students to identify plate boundary types seen in the drawing.
2. Instructor explains why a volcano exists here using the visual aid of the drawing.

Eruptions and Hazards

1. Instructor asks students to describe what happens when a volcano erupts. What kind of stuff comes out of a volcano like Mount Rainier when an eruption happens? Instructor guides students to categorize this stuff into lava, tephra, and lahar debris.
2. Students are asked to think about which of these categories poses the greatest threat to humans, and students will rate them from 1-3, 1 being the greatest hazard and 3 being the least threat to human populations. After a general consensus is reached within the group, the hazard map and overlays are passed out one at a time.
3. Students are asked to make observations about the areas covered by each overlay. Students should notice that lava covers a very small area where no people live, tephra covers a pretty large area, but no large urban areas, and lahars flow into many large urban areas. Hopefully, students will then need to modify their previous rating of these hazards.

Conclusion

1. Instructor can conclude this activity by pointing out the large andesite lava flow in the background, and by passing around a lahar sample to show students what kind of stuff comes down in a lahar.
2. Students also generally want to know if they should be scared of Mount Rainier erupting anytime soon, and the instructor can describe eruption monitoring that is going on 24/7 on the mountain.

Learning Context:

Possible Extensions:

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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WEATHER AND LIFE ZONES

At a Glance

Grade Level(s): 6th-8th

Time Required: 20-30 minutes

Activity Summary: Students review the water cycle and get an introduction to the Orographic Lift (Rainshadow Effect), life zones, and adiabatic cooling. This lesson is very visual and requires students to work in small groups but is mostly sedentary.

Materials Needed:
- Whiteboard and dry erase markers (1-2 whiteboards, depending on how you want to draw and write the information in this lesson)
- Washington precipitation maps (enough to have students in groups of 2-4)
- Life Zone cards

Learning Objectives. Students will be able to…
- Interpret data on a map showing precipitation levels in the state of Washington.
- Describe the process of orographic lifting (the rainshadow effect) and how it affects the precipitation levels in Washington state.
- Predict the temperature at higher elevations using normal lapse rate.

Key Words: Life zone, adiabatic cooling, orographic lift, rainshadow effect, normal lapse rate, precipitation

Details

Background:

Average decrease in temp with increase in elevation: 3.5 degrees F for every 1,000 ft elevation gain.

Procedure:

OROGRAPHIC LIFTING/RAINSHADOW EFFECT

1. Start by telling the students that you're going to be talking about weather and mountain ecosystems.
2. Hold up the Washington Precipitation Map and explain that the students will work in small groups to make observations about what they're seeing on the map. If these are younger students or students who might need more help figuring out how to read the map, point out the title and legend (or, key) as resources for them to pay attention to. Tell the students they will have a few minutes to talk with their group about what they see on the map and then each small group will have a chance to share with the whole group.

3. While the students are looking at the map, walk around and check in with each group about how they're doing and what they're seeing. Point them in the direction of making more detailed observations or challenge them to infer things about what they're seeing on the map.
4. Once students have had time to look at the map and make observations within their small groups, get everyone's attention and ask which group would like to share first. Have each group share 1-2 observations. Once all the groups have shared, ask if there are any other observations they want to bring up.
5. Make sure someone mentions that it's dry on the east side and wet on the west side, that the Cascade mountain range is the divider between wet and dry, and that there are little pockets of dry very dry (yellow on the map) and very wet (pink and purple on the map). Talk about where those places are (Sequim, Hoh rainforest, Mount Rainier, etc) and ask if anyone has an idea of why the precipitation levels there might be different from the surrounding area.
6. Tell the students there's a fancy science word for this phenomenon called Orographic Lifting, or the Rainshadow Effect. Write both of these words on your whiteboard so that visual learners can see it.
7. Draw a mountain on your whiteboard to represent the Cascades. Illustrate a cloud forming from the Pacific Ocean, being blown east by ocean winds, and moving higher in elevation in order to move over to the east side of the mountain.
8. Explain that as the cloud gets higher in the atmosphere it is harder for the water molecules to stay together, and it dissipates, raining and snowing on the landscape beneath it.
9. Check for understanding before moving on to adiabatic cooling.

ADIABATIC COOLING

1. Review what happened with the cloud as it rose higher in the atmosphere. (The air cooled, water molecules dispersed, etc). Using the whiteboard with the mountain on it, explain that the scientific word for the air temperature going down as the elevation or altitude goes up is Adiabatic Cooling. Write this word on the other whiteboard.
2. Repeat this word a few times, slowly, and especially with younger students, have them repeat the word. With older students you could have them write these words in their journal as a way to practice taking notes.
3. Explain that the simple equation for this is that for every 1,000 ft you go up in elevation, the temperature goes down 3.5° F. This is also called the "normal lapse rate."

LIFE ZONES

1. Have the life zone cards nearby but not in view of the students. Ask students what the very top of a mountain looks like. Or, if Mount Rainier is visible, ask them to look at the top of the mountain and make observations about what it looks like.
2. Pull out the Alpine life zone card and show them the picture on the front. Tell them that this represents the "life zone" at the top of the mountain. Around here, this life zone starts at around 7,000 ft.
3. Using the whiteboard with the mountain drawn on it from earlier (or if doing as a stand-alone lesson, draw a mountain on your whiteboard), draw a line across the mountain about ½ to $^{2}/_{3}$ of the way up (realistically, 7,000 ft is halfway up Mount Rainier) and label it "Alpine." I write the elevation too, to give students the visual.
4. Have the students share ideas about what kinds of plants or animals might live in the alpine and what kinds of adaptations they might need.
5. Ask students what it looks like at Pack Forest (big trees, lots of moss, etc.). Pull out the Lowland life zone card and show them the picture on the front. Tell them that this represents the life zone from sea level to about 2,000 ft.

6. Draw a line at the bottom of the mountain and label it "Lowland." Write down the elevation. Have the students share ideas about what kinds of plants or animals might live in the lowland and what kinds of adaptations they might have.
7. Tell the students that there are two more life zones, and draw a line to divide the mountain into two more sections. Ask the students what they think it might look like in the life zone right below the alpine. Have them share ideas, then pull out the Subalpine life zone card and show them the picture on the front. Tell them that this represents the life zone from about 2,000 to 4,000 ft. Label it with the name and elevation range.
8. Ask the students what kinds of plants or animals might live in the subalpine and what kinds of adaptations they might need.
9. If doing this at Longmire, tell the students to look around them and make some observations about their surroundings. Ask them if this place has any differences from Pack Forest. (Temperature is often something they'll bring up, or in the early spring, snow.)
10. Tell them that they are in a different life zone here than at Pack Forest. Pull out the Montane life zone card and show them the picture on the front. Tell them that this represents the life zone from about 2,000 to 5,500 ft. Label it with the name and elevation range.
11. Ask the students what kinds of plants or animals might live in the montane and what kinds of adaptations they might have.
12. Refer back to adiabatic cooling and orographic lifting in talking about the kinds of adaptations animals and plants might need in order to survive at different elevations on the mountain.

Learning Context: This should be done somewhere in the first half of the students' time at Mount Rainier Institute so that students can continue to make observations and connections about the life zones and weather they're seeing throughout their program.

Possible Extensions:

- Have students calculate the temperatures at different elevations using the normal lapse rate equation.
- Use this as an opportunity to teach or review the water cycle.
- If there's more time or you're working with older students, you can talk about the differences between life zones on the east and west sides of the Cascades.

Adaptations for different learning needs:

- For a group of students at a lower level of understanding, or who need more of a hands-on approach (this works great for elementary school students), instead of showing orographic lifting on the whiteboard, act it out: use tinfoil to create a mountain (usually by putting the tinfoil over the top of something to create that mountain shape), have a bucket of water on the "west" side of the mountain to represent the ocean, and use a sponge for a cloud. Show the cloud traveling "east" and raining/snowing more as it goes up and over the mountain, then having only a small amount of water left for the east side. Students can take turns moving the wet sponge over the mountain and making it rain/snow to practice this concept.
- This activity could be done with more "think-pair-share": students pair up and talk about the prompt together, then one person from each pair can share with the larger group. This works well for ELL students (or students who are shy) who aren't necessarily comfortable speaking in front of the group.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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IMPORTANCE OF WATER

At a Glance

Grade Level(s): 6th-8th grade

Time Required: 20 minutes

Materials Needed:

- 32 oz. water bottle
- 1 Syringe with ml measures
- 2 small containers capable of holding at least 17 ml each
- Watershed map
- 2 bandanas
- Plant leaf
- Salt
- Snowflake (paper cut out)
- Food item

Activity Summary: In this activity students will hypothesize, investigate, and discuss the distribution of water on the earth by participating in a hands on water activity. They will also be engaged in a conversation about what watershed they live in, where their water comes from geographically and literally (ie. Rainwater or snowmelt).

Learning Objectives. Students will be able to…

- Identify the watershed in which the students come from on a map
- Describe why a river flows over the landscape as it does
- Demonstrate the earth's distribution of water using the given materials

Vocab Words: Adiabatic Cooling. Geology. Precipitation. Rain shadow. Watershed.

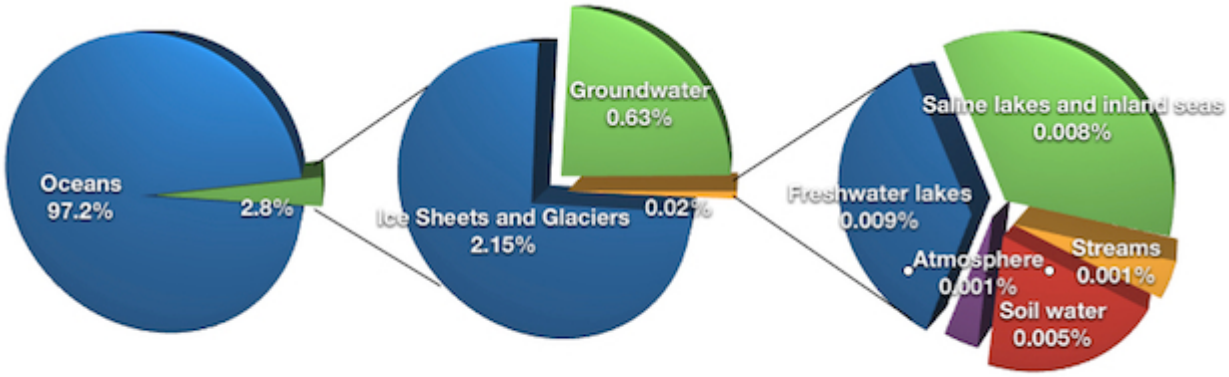
Details

Background:

Water or H_2O as it is commonly referred to is the most common compound on the surface of the Earth. In fact water covers about 71% of earth by area and about 326,074,000 mi^3 by volume. Earth's hydrosphere has stayed at a steady state equilibrium for the last 2 billion years. This means that even though the Earth is constantly losing water molecules to space and water molecules are always changing by bonding with other compounds there is roughly the same amount of water on the surface of the Earth at any given time, now how is this possible?

This equilibrium is maintained by a process we know as outgassing. Outgassing is when water and water vapor emerge to the Earth surface from at least a depth of 15.5 miles below the crust. Typical routes of this water emergence happens via geysers, springs, fumaroles, terraces, and other geothermal features. The point to all this is there is no more or no less water on the surface of the earth than there was 2 billion years ago, it is just in different geographic locations.

The distribution of water is roughly broken down as the graphic below shows:



Procedure:

Set up: Place the full water bottle, food item, snowflake, salt, and plant leaf in between the two bandanas.
Instructions:

- Instruct the students to come close and observe with their eyes only what is underneath the bandana.
- Lift the bandana for 20 seconds then recover the items.

Ask:

- How many items were underneath the bandana?
- What were the items?
- What is one thing these items have in common?

Outline the thread that ties all these items together, if you said water that is correct!

Set up: 33 oz of water in water bottle = 1 liter = 1000ml , 2 small containers capable of holding 21 ml each, syringe.

Instructions:

- Introduce the water bottle as representing all the water on earth
- Proceed to ask for volunteers to withdraw water from the earth in the following amounts:

21.5ml represents all the water stored in ice and glaciers
6ml represents all groundwater
3.2 drops of water represent all the freshwater lakes, rivers, and streams

The 972 ml that is left represents all the water contained in the oceans
The water that was manipulated and divided was 28ml which represents all the fresh water on earth.

Ask the students where their water comes from? Allow them to point out their home watershed on a map. Ask the students why the watershed is shaped in such a way? At this point what you want for your students is to connect that

geology effects physical water distribution in the form of area of watersheds and also they may be directly affected by the rain shadow effect.

Learning Context: This activity is typically completed at Longmire where it is easy to see water that is sourced in different ways (springs, snowmelt streams, glacier fed streams). However, if you have a group focusing on water quality this is an activity that works very well back at Pack Forest on the first day especially if the extension is added.

Possible Extensions:

After calling to attention the small percentage of freshwater on our planet you can lead into waterfront property.

Setup: Journals, pencils, land use map, colored pencils or crayons.

Instructions: Tell the students to flip open to a blank page in their journal. Then proceed to tell them that they have just inherited some of this very valuable waterfront property from a Great Aunt. They can do anything they want with it; build a home, business, school, hospital, retreat, or a farm. Allow the students time to work on their creations then have them present their land to the group. After the presentations have the students connect their water as if it is a river with developed land on both sides of the river. Investigate what is upstream and downstream from your home. Are there any concerns? Now take a look at the land use map, what concerns do you see, if any? How does this affect the local waterways and why do we care?

Adaptations for different learning needs:

- This activity lends itself nicely to needing helpers for the water with drawl process which can engage students that need a job.
- If there is a student that is blind you may pour out some of the items in the observation activity and allow the student to touch the items under the bandana.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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GLACIER GOO

At a Glance

Grade Level(s): 6th-8th

Time Required: 20-30 minutes

Materials Needed:
- Glacier goo (gak)
- Gutters (3)
- Whiteboard (optional)
- Dry erase markers
- Fir needles or some other small natural material
- Stopwatch or timer

Activity Summary: Students are split into groups, they receive a plastic grid gutter and some glacier goo (silly putty). Glacier Goo is placed at one end of the gutter, one end of the gutter is elevated and fir needles and/or rocks are placed on surface of Glacier Goo to mimic trees. Students make observations of glacier as it moves down the gutter.

Learning Objectives. Students will be able to…
- Students will be able to describe the way in which a glacier moves.
- Students will be able to explain which part of the glacier moves the fastest.
- Students will be able to identify the different parts of a glacier.

Vocab Words: Glacier. Ablation. Terminus. Recede. U-shape valley. Moraine. Lateral moraine. Terminal moraine. Basal slip. Internal deformation. Glacial erratic.

Details

Background:

Glaciers are slowly moving masses of ice formed by the accumulation and compaction of snow on mountains or near the poles. They occupy about 10% of the Earth's land, mostly in Greenland and Antarctica. Here, glaciers can be as much as 2 miles thick and weigh millions of tons. As they move, glaciers can widen and deepen valleys, flatten forests and grind boulders into pebbles.

Mount Rainier National Park is comprised of 25 different glaciers. It has the largest glacial mass in the United States outside of Alaska. (North Cascades National Park has the highest number of glaciers outside of Alaska,

though they are smaller than Mount Rainier's glaciers.) Currently, all of the glaciers at Mount Rainier are receding, which means that they are losing more mass than they are gaining.

There are some common misconceptions about how glaciers commonly move—some think that they just glide across the surface of the land (basal slip), but you will in fact discover that it is more of a rolling motion (internal deformation). Another thought is that glaciers act as bulldozers where they push rocks into a moraine, however, those rocks have fallen on top of the glacier or have been picked up by them and are then deposited into ridges. These ridges are called lateral and terminal moraines. Through this movement, the glacier carves out a U-shaped valley.

Digging Into The Vocab Words

- Glacier: a slowly moving masses of ice formed by the accumulation and compaction of snow on mountains or near the poles.
- Ablation: the removal of snow and ice by melting or evaporation.
- Terminus: the end point of a glacier.
- Recede: when a glacier is losing more mass than it is gaining.
- U-shape valley: glaciers carve a U-shaped valley vs. a V-shaped valley for rivers
- Moraine: a mass of rocks and sediment carried down and deposited by a glacier, typically as a ridge
- Terminal moraine: the furthest point a glacier has reached
- Lateral moraine: the ridges that have formed along the sides of the glacier
- Basal-slip: a glacier sliding down a slope
- Internal deformation: the ice of a glacier remains frozen, but rolls down the slope in a conveyor belt-like motion
- Glacial Erratic: is a piece of rock that differs from the size and/or type of rock native to the area in which it rests.

Procedure:

1. Provide an introduction to glaciers using the information and vocab provided in the background. Modify this based on your group (size/age level).
2. Split group into 2-4 teams (depends on size of group and age level).
3. Hand each team a grid gutter and have them decide on an angle that they would like to have their glacier at. Make sure that the gutter is resting against something (snow, backpack).
4. We will be timing how fast your glacier will move in two minutes.
5. Place glacier goo at top of gutter slope and mark (with grease pencil or dry erase marker) the starting terminus on the grid. Hold glacier in place until the stopwatch has been started.
6. Place a few fir needles (mimic trees) or small rocks into the top of the goo.
7. Make sure all teams are ready- starting terminus marked on grid, trees and rocks placed, hold glacier in place.
8. Tell students that they are to make observations of the glacier shape, movement, and change in trees and rocks. Start the timer. Instructor will walk around and facilitate the observations made by students.
9. Stop timer at 2 minutes. Have students mark their ending terminus on the grid. Count how many grid blocks the glacier moved within the 2 minutes.
10. Have students share within their team the observations that they made while the glacier moved. Allow approximately 45sec-1min. for discussion.

11. After discussing in their groups, have each team share with the entire trail group their glacier speed and angle. Whose glacier moved the fastest? Why?
12. Call on at least one person per team to share their group's observations.
13. Additional questions to ask at the end:
    a. What part of the glacier flows the fastest? Why?
    b. How might glaciers speed up?
    c. How would you describe the movement of a glacier?
    d. Why is it important for scientists to find out how fast glaciers move?

Learning Context: This activity would be taught when you are at Paradise in Mount Rainier National Park. It works best when you are on the Nisqually Vista trail, at one of the outlooks for the Nisqually Glacier. During your introduction/background information for the lesson, you can refer to the Nisqually Glacier, pointing out the terminus, moraines, U-shape valley and glacial erratic's. You can also pair this lesson with the Life Cycle of a Glacier either prior or after this activity. This activity is used as an extension to the topic of glaciers. After receiving background information about glaciers (what a glacier is, where they are, and vocab words), you lead into this activity to elaborate and show an example of glacial movement.

Possible Extensions:

If time permits, allow students to try different angles to place their gutter, add more or less goo to their glacier and/or more or less debris added to.

For older students, have them calculate the rate at which their glacier moved—grid blocks per second. (Grid number divided by seconds). Each grid block is 5mm.

Adaptations for different learning needs:

- Split your students into teams based on their needs (age and skill level). Maybe you need to make the teams smaller or larger with the potential addition of a chaperone to aide in assistance with directions.
- Depending on the students age and skill level (higher elementary-high school), have them calculate the rate of speed of their glacier.
- Also, depending on the age and interest of the students, you don't have to turn the activity into a race, they can just watch the glacier goo move down the gutter.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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SNOW STUDY

At a Glance

Grade Level(s): 6th-8th

Time Required: 45 minutes

Activity Summary: Students explore the snowy landscape and work in small groups to calculate the percentage of water in the snow.

Materials Needed:
- Shovel (optional)
- Cans
- Thermometer
- Calculator
- Scale (in kg)
- Snow Water Equivalent worksheets
- Grease pencils or dry erase markers for worksheets

Learning Objectives. Students will be able to…
- Students will be able to calculate snow density and understand how that is used to find the snow water equivalent for water supply forecasts.
- Students will be able to explain why mountain snowpack is important to our water supply.

Key Words: Snowpack Telemetry (SnoTel), Snow Water Equivalent (SWE),

Details

Background:

Why is snow science important? Avalanches, effects of snow on animals and plants (adaptations, can connect to life zones), major source of water (drinking water, irrigation, recreation).

Formation of Snow Crystals/Snowflakes

Snowflakes are conglomerations of frozen ice crystals that fall through earth's atmosphere. There is a variety of shapes and sizes, and most snowflakes are unique—this comes from the many different combinations of temperature and humidity they travel through while being formed.

Snowflakes form when an extremely cold water droplet freezes onto a particle of pollen or dust in the sky. This creates an ice crystal. As the ice crystal falls to the ground, water vapor freezes onto the primary crystal, building new crystals—the six arms of a snowflake.

Snow Crystal Shapes

There are several factors that affect the shape of snow crystals. Fresh snow crystals are shaped by the temperature and moisture of the cloud that the crystal forms in. For snow already on the ground it is temperature (snowpack, air), pressure on the crystal, wind, and time.

Snowflakes begin as a hexagonal plate-like crystal, as it forms around a microscopic particle of dust or pollen. Depending on the air temperature and moisture it might stay like that or it might grow into a star-like or cylindrical-shaped crystal. Star-like crystals (also called "Steller") grow out along the basal plan (you could say it grows "out," not "up") and turn into the shapes we generally think of when we think of a snowflake—a branching star-like pattern. Cylindrical-shaped crystals grow 90 degrees to the basal plane (these ones grow "up," not "out"—they become more 3-D) and become needle or column-like.

In any of these snow crystals, the hexagonal structure of the crystal itself means that the molecules in the middle are attached on all sides and are very stable while the surface molecules are not as stable since there is less for them to attach to. This changes how the crystal looks on a molecular level and is why snow crystals lose their overall shape over time but keep their inner hexagonal core.

Stellar crystals are the classic snow crystal. They form in moist clouds near -15°C and is a central hexagonal plate with 6 symmetric arms, which gives them a high surface to volume ratio. These crystals are thermodynamically unstable, meaning they melt easily, don't hold their shape very well, and disappear instantly when they land on your jacket (unlike plate-like crystals which hit your jacket and stay there for a while).

Plate-like crystals are another common snow crystal. They form in a wide variety of cloud conditions—same -15°C temperature area but dryer than stellar crystals. These crystals look like a symmetric hexagonal plate.

Column-like crystals form in a wide range of cloud temperatures but in colder conditions than steller or plate-like crystals, generally around -25°C, and can look like Gothic/Greek columns or like bullets/head of a nail. A variation of column-like crystals are Capped Columns. With this crystal, the columns form first, then fall through conditions that form plates on both ends of the columns. Very rarely do we get column-shaped snow crystals here because it's not cold enough—maybe at the summit of Mt Rainier.

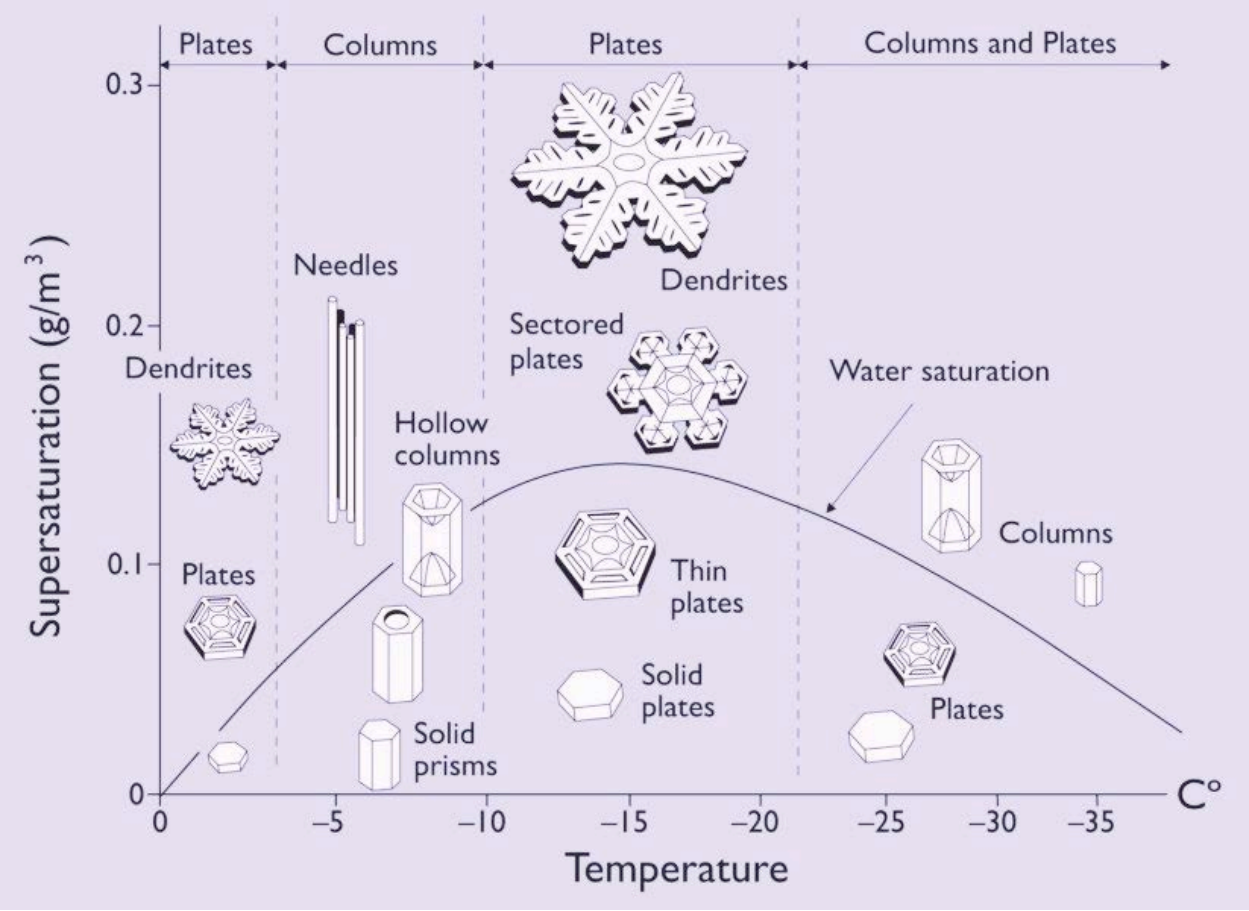
Needle-like crystals form in warm, wet clouds, again at around -5°C.

Rime is when super cooled liquid water droplets (not ice, but still below freezing) freeze onto a snow crystal. It can also form on trees, rocks, and other structures. It is similar to Hoar frost, which is when gas water vapors fall (deposit) on the surface of snow.

Graupel is an amorphous blob of heavy rime that forms in warm, really wet weather. The crystals fall through liquid water droplets for a long time, attaching to each other. This is slightly different than hail (though they can look very similar) because while graupel simply falls for a long time, hail circulates in the atmosphere, building lots of layers, and forming a ball of heavy ice. Because of it's condensed structure, graupel persists for long time

in it's current shape within the snowpack. This creates weak layer in the snow because it's basically a bunch of little balls, which creates slip between two layers.

Temperatures at Which Different Kinds of Snowflakes Form



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Snowpack Profile

Digging a snow pit allows you to closely examine the snowpack. The snowpack consists of identifiable layers (sight, touch, taste). Each layer has its own properties—density, hardness, crystal type. Some things to look for are sun and wind crusts.

A sun crust is a hard ice crust that forms from snow melting and re-freezing (when the top layer of snow goes through one or several warm and cold cycles before any new snow falls). A wind crust is when snow crystals are broken by the wind and fragments have frozen back together

Snow Density and Snow Water Equivalent

Snow Water Equivalent (SWE) is a common snowpack measurement. It is the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack instantaneously.

According to the USDA, most snow that falls in the Cascade Mountains of Washington and Oregon tends to be higher density snow. In the Cascades, snowpack densities are around 20-30% in the winter and 30-50% in the spring. However, east of the Cascades, the snowpack density is much less. Typical values are 10-20% in the winter and 20-40% in the spring.

The National Weather Service indicates that the average SWE is a ratio of ten inches snow to one inch rainfall, more densely packed and wet snow is a ratio of eight inches snow to one inch rainfall, and more powdery snow is a ratio of 14 inches snow to one inch rainfall.

Calculations:

- Snow Mass ÷Volume of Container = Snow Density
- Snow Density × 100 = % of water in your snow sample
- Snow Density × Snow Depth = Snow Water Equivalent

Fun Fact: there are 10 quintillion (that's 10,000,000,000,000,000,000) water molecules in one snowflake.

Another Type of Water—Rain:
Raindrops form when tiny water droplets condense on even smaller particles of dust, smoke, or salt, which act as a nucleus. The drops grow as they collide with other water drops or water vapor. The water drops fall from the cloud if they have a fall velocity that exceeds the updraft speed of the cloud. One inch of rain falling on one acre of ground is equal to about 27,154 gallons and weighs about 113 tons.

Procedure:

1. Start by asking students why, or if, water is important. Hopefully they will know that water is indeed an important resource, and will have some ideas for why. (They should come up with examples like irrigating crops, drinking water, recreation, etc.) If they missed anything, bring it up or challenge them to think of more examples.
2. Tell the students that there are scientists who study snow and measure the water content in the snowpack. Tell them that today they are going to have a chance to go through that same process on a smaller scale.
3. Demonstrate how to take a snow sample

Learning Context: This activity is done at Paradise on the Mount Rainier day.

Possible Extensions:

- Have students take the temperature of different layers in the snowpack.

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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DAY 4

The purpose of the final day is to

Goals:

- Students will show measurable growth in their comfort level outdoors and their knowledge about natural systems.
- Students will be able to start connecting their experience at Pack Forest and Mount Rainier National Park to their home environment.
- Students will use teamwork to complete teambuilding challenges, games, and activities with their trail group.
- Students will be able to describe Nature's Benefits in terms of economic, ecological, and cultural.

RESEARCH SYMPOSIUM

At a Glance

Grade Level(s): 6th-8th

Time Required: 30 min – 1 hr (depends on group size)

Activity Summary: The research symposium is designed to let students practice giving a presentation to their peers and teachers. It is the culmination of their field study. Each trail group will give a presentation on the research they did, then stay in the front and answer questions at the end of their presentation. Presentations should aim to be about five minutes long.

Materials Needed:
- Projector
- Computer
- Easels & tape (to pin up posters)
- MORA research power point presentation

Learning Objectives. Students will be able to…
- Present and discuss their research in front of their peers
- Answer questions about their research project and make connections to other research/world events

Vocab Words: Symposium

Details

Background:

Scientific findings are irrelevant unless they are analyzed, shared and communicated clearly. One common format for sharing information is at a science conference, or symposium, where scientists report their research by outlining their research question, hypothesis, methods, results, and conclusions. Such presentations are not complete without questions from colleagues and peers that clarify, extend, or challenge the results and conclusions of the research. It is important that our students get this opportunity as part of their scientific process.

Research in the National Park:

There's a lot of research going on in national parks. Scientists submit their research proposal to the park and if it's interesting, needed information, and they have enough resources the park will give the scientists a research

permit. Some of the topics that Park Researchers study are climate, glaciers, landscape dynamics, mountain lakes, water quality, elk, land birds, forest vegetation, and vegetation in the alpine and subalpine.

Some current examples of actual studies in Mount Rainier National Park include:

- A long-term study to assess changes in vegetation at different elevations due to climate change.
- Examination of alpine aquatic ecosystems to better understand the role of post-glacier landforms in the area's hydrology.
- An ongoing project using the park's seven weather stations to monitor weather in the park to understand variations in other park resources such as plants and glaciers.
- Studies documenting the presence of fish introduced in mountain lakes.
- Ongoing changes of glaciers and major rivers of Mount Rainier.
- Long-term ecological monitoring of mountain lakes.

Scientists studying land birds are revisiting predetermined transects throughout the year to collect numbers on how many species there are, the number of exotic species, and the species density.

Climate scientists are studying temperature, precipitation, snow depth, snow water equivalent, amount of snowfall, wind speed and direction, humidity, solar radiation, and soil temperature and moisture. They are monitoring changes over time as well as using this data to predict forest fires.

Scientists studying forest vegetation are measuring canopy cover, tree growth, tree mortality, and tree recruitment, as well as the number of snags.

Scientists studying water quality are measuring benthic macro-invertebrates, dissolved oxygen, pH, habitat, temperature, and turbidity to ensure that our headwaters are unimpaired within park boundaries. They are also using these measurements in direct correlation with climate change.

This science is really important for a few reasons. One big reason is so we have baseline data. Being able to show changes over time is also really important because it allows us to see trends in the data. There's also a total elevation change of 12,800 ft in Mount Rainier National Park, which means it's a great place to find a lot of species variation and different habitats/microclimates to study.

There are several citizen science programs happening in the park right now that you can get involved in.
Citizen Science (also called civic science or volunteer monitoring) is scientific research conducted by amateur scientists. In part because of technology, scientists are able to use regular people who want to help with really important research. And because there are a lot of people getting involved, we have the potential to gather a lot of data and have bigger sample sizes.

- The Amphibian Monitoring Program is actively seeking volunteers for amphibian surveys. There is information about how to get involved on the park website.
  For the Butterfly Monitoring Program, you're assigned a transect to walk and identify certain species of butterflies.
- Meadow Watch takes no training and is probably the easiest one to take part in. They're asking people to take pictures of spring flowers with their smart phones and then upload the pictures to a website. The people running the project are then taking the GPS data from the picture and entering it into a database that tells them when and where certain wildflowers are blooming. Over time, this is going to tell us if certain flowers are

starting to bloom later or earlier than normal, and if their growing location is changing, which relates back to climate change.

- Scat Collection is a joint effort between the National Park and the University of Washington. they're asking people to bring ziplock bags into the backcountry and collect scat, write the location on the bag, and send it to the university for DNA testing. They're using this data to figure out territories of large mammals.

Procedure:

Introduction:

1. Welcome the students and other attendees (chaperones, teachers, Naturalists, other guests) to the Symposium. Ask/explain what a symposium is and why it is important. Talk a little about the kinds of research the different trail groups worked on this week.
2. Introduce students to the current research going on in Mount Rainier National Park (start the MORA research power point presentation)

MORA Research Power Point - Presentation Notes:

1. **MORA**: There's research, just like you all were doing, that's happening in national parks! If you're a scientist and you have a research proposal for something you want to study in Mount Rainier National Park, you submit your proposal to the Park and if it's a good enough idea and you have enough resources they'll give you a research permit.
2. **OVERVIEW**: Some of the topics that Park Researchers study are climate, glaciers, landscape dynamics, mountain lakes, water quality, elk, land birds, forest vegetation, and vegetation in the alpine and subalpine. There's a long-term study to assess changes in vegetation at different elevations due to climate change. Examination of alpine aquatic ecosystems to better understand the role of post-glacier landforms in the area's hydrology. An ongoing project using the park's seven weather stations to monitor weather in the park to understand variations in other park resources such as plants and glaciers. Studies documenting the presence of fish introduced in mountain lakes. Ongoing changes of glaciers and major rivers of Mount Rainier. Long-term ecological monitoring of mountain lakes. I'm going to go a little more in depth into a few of these topics.
3. **LANDBIRDS**: For land birds, scientists are revisiting predetermined transects throughout the year to collect numbers on how many species there are, the number of exotic species (those are the species that aren't native to this area), and the species density.
4. **CLIMATE**: For climate, scientists are studying temperature, precipitation, snow depth, snow water equivalent, amount of snowfall, wind speed and direction, humidity, solar radiation, and soil temperature and moisture. They are monitoring changes over time as well as using this data to predict forest fires.
5. **FOREST VEGETATION**: Scientists studying forest vegetation are measuring canopy cover, tree growth, tree mortality (which is tree death), and tree recruitment (the number of seedlings), as well as the number of snags.
6. **WATER QUALITY**: Scientists are measuring benthic macro-invertebrates (insects and other organisms in the water), amount of dissolved oxygen in the water, pH (which is the acidity of the water), habitat, temperature, and turbidity (the total suspended sediment in the water, which affects water clarity) to ensure that our headwaters are unimpaired within park boundaries. They are also using these measurements in direct correlation with climate change.
   For example, if the forest vegetation is affected and the shade goes away over a stream then the temperature will rise, which affects the macro-invertebrates that live in the stream…which affects the animals that eat the macro-invertebrates, and so on.
7. **WHY**: So why is this important? Why are scientists doing this research and why did I just stand up here for 5-10 and talk to you all about it?

One big reason is so we have baseline data. As a scientist, you can't say something is happening without having data to back it up. So having a point where you can start from and show that the data changes over time is really important. This also allows us to see trends over time. Another reason why Mount Rainier National Park is such a great and unique laboratory for all this science is because there's a total elevation change of 12,800 ft in the park. That means a lot of species variation and different habitats/microclimates to study.
[Before moving on to the next slide, point out and talk about the photograph on this slide]

8. **WHAT CAN YOU DO**: So what can you do? There are several citizen science programs happening in the park right now that you can get involved in.
   Citizen Science (also called civic science or volunteer monitoring) is scientific research conducted by amateur scientists. That means you! In part because of technology, scientists are able to use regular people who want to help with really important research. And because there are a lot of people getting involved, we have the potential to gather a lot of data and have bigger sample sizes.
   The amphibian monitoring program is actively seeking volunteers for amphibian surveys. There is information about how to get involved on the park website.
   For butterfly monitoring, you're assigned a transect to walk and identify certain species of butterflies.
   Meadow Watch takes no training and is probably the easiest one to take part in. They're asking people to take pictures of spring flowers with their smart phones and then upload the pictures to a website. The people running the project are then taking the GPS data from the picture and entering it into a database that tells them when and where certain wildflowers are blooming. Over time, this is going to tell us if certain flowers are starting to bloom later or earlier than normal, and if their growing location is changing, which relates back to climate change.
   Scat collection is a joint effort between the National Park and the University of Washington. they're asking people to bring ziplock bags into the backcountry and collect scat, write the location on the bag, and send it to the university for DNA testing. They're using this data to figure out territories of large mammals.

Learning Context: This is generally done on the morning of the last day (day 4), though it can be moved to another time/day to accommodate shorter programs or different goals.

Possible Extensions:

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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NATURE'S BENEFITS ASSESSMENT

At a Glance

Grade Level(s): 6th-8th

Time Required: 15-20 minutes

Activity Summary: Students will be put into small groups with a set of cards. Each group will work together to put their cards with "Ecological," "Economic," and "Cultural" benefits.

Materials Needed:
- Activity cards (multiple sets per trail group)
- White board (optional)

Learning Objectives. Students will be able to…
- Students will be able to engage in conversation about nature's benefits
- Students will be able to show which activities are ecological benefits, economic benefits, and cultural benefits

Key Words: Nature's benefits, ecological/ecology

Details

Background:

Procedure:

1. Students are divided into groups of 3-4 and each group is given a set of activity cards.
2. Students work with their group to sort the cards into three categories—economic benefits, ecological benefits, and cultural benefits.
3. Once all cards are sorted gather the group to talk about why they put certain cards under certain headings. If there's disagreement about some cards decide as a group whether or not they should be moved, and why.

Learning Context: This is part 3 of the lesson. If possible, this activity should be done right before the silent hike.

Possible Extensions: Draw this activity into the silent hike (extra silent hike cards? Writing prompts?). Personal aspect of being in nature—what do you get out of being in nature, how does it benefit you?

Adaptations for different learning needs:

· Add a "help station" if needed (instructor asks students a question to help them get to the answer)

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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SILENT HIKE

At a Glance

Grade Level(s): 6th-8th

Time Required: 30-60 minutes

Materials Needed:
- Silent hike cards

Activity Summary: Students will walk individually along a trail and reflect on their experience at MRI by reading and thinking about questions on silent hike cards.

Learning Objectives. Students will be able to…
- Experience being alone in the forest in a controlled and safe environment.
- Reflect on their experiences at MRI through prompts on the silent hike cards
- Write a journal entry about their silent hike and/or their experience at MRI

Vocab Words:

Details

Background:

Rarely do students get the opportunity to spend time hiking alone. This activity is designed to give them that experience in a controlled and safe environment. Through this alone time on the trail, students are able to better focus on their senses and their surroundings, and reflect on their experiences at MRI.

Procedure:

1. Plan a location for the silent hike that is an easy and well-established trail, where students are in no danger of taking a wrong turn.
2. Explain to students that they will be walking alone along the trail in a safe and controlled environment, with the purpose being to spend some time alone to reflect on their experiences.
3. Explain that you will place cards along the trail periodically. Some cards will pose a question, some will ask you to do something, and others will ask you to use your senses to observe your surroundings. Students are to read the card, do whatever the card asks, and leave the card in its place as they keep walking.

4. Ask the chaperone to time students, and send them down the trail about one minute apart from each other. It is usually beneficial to write out an order to send them in before the activity, so that students do not argue about this. This is also helpful in managing group dynamics.
5. Remind students that they are to walk slowly and enjoy their time alone. If they see a student ahead of them, they should slow down and give that student their space.
6. Tell the students that at the end of the silent hike, they will be doing a journal activity. They will be writing (or drawing) a reflection on either their experience on their silent hike, or a reflection on their time at MRI. When they reach the end, they should not disturb other students and quietly get out their journal and start their reflection.
7. Ask the chaperone to pick up the silent hike cards at the end, when the chaperone follows the last student.
8. Walk along the trail and place silent hike cards. If there is a junction in the trail, make sure to also place several directional cards so that students are in no danger of taking a wrong turn.
9. When all students are finished with their silent hike, give the final student at least five minutes, preferably more, to write their reflection. This means that the students that go first will have much more time for their reflection. Careful thought on the order that you send the students in is necessary in order to manage group dynamics and give some students more time if needed.

Learning Context: This activity works best when done toward the end of the final day of programming so that students are able to reflect on their experience.

Possible Extensions:

· This activity makes a nice clean transition into a group wrap-up, after they have some time to do some individual reflection. It is also possible to extend the final journal activity into a longer sit-spot.

Adaptations for different learning needs:

· If students are very nervous about walking alone in the forest, it is possible to send them in pairs. However, the instructor should be very careful about group dynamics in this situation. It is also possible to send them farther apart from each other if time allows.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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ROSE, THORN, BUD

At a Glance

Grade Level(s): 3rd-12th

Time Required: 15-20 minutes

Activity Summary: Students will have a chance to reflect on their experiences at Mount Rainier Institute and write about it in their journals.

Materials Needed:
- Student journals
- Pencil
- Whiteboard & dry erase markers (optional)

Learning Objectives. Students will be able to…
- Reflect on their experiences during their time at Mount Rainier Institute
- Answer the "big picture" question of why they are at Mount Rainier Institute
-

Key Words:

Details

Background:

Students have hiked, played in snow, lived together, and worked on teambuilding, all while learning at Mount Rainier Institute. Over the past few days, every participant has collected experiences and has molded his/her/their overall impression of nature, the outdoors, education, and Mount Rainier Institute. It is crucial for students to share their experiences while those memories are fresh. Use this time to let students vent, if needed. Some might experience frustration at potentially new and different challenges over the week.

Procedure:

1. Find a quiet, relatively open section of trail for students, large and comfortable enough to sit for 15 minutes.
2. Have students sit on the ground, introduce Rose Thorn Bud. Have them reflect on and write down their favorite experience at Mount Rainier Institute, their most challenging experience, and one experience they will share with others upon their return to school/home. Then, let every student share thoughts.

3. After Rose Thorn Bud, ask students why they are here at Mount Rainier Institute. Has their viewpoint on this trip changed since arrival?
4. Wrap up activity by explaining to students the goal for the group (if one was established). [Was it for them to enjoy being outside? To overcome a particular fear found in nature (spiders, etc.)? To improve on working together?] Was that accomplished? Explain their positive experiences in nature can continue by visiting their local parks (state, National), rivers, and similar nature-filled locations.

Learning Context: This is done as a wrap up at the end of the final day, right before lunch.

Possible Extensions:

Adaptations for different learning needs:

· If needed, you can write down students' schedules on your whiteboard to help recap their week

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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EVENING PROGRAMS

Evening programs are designed to help foster a community within the group of students and their instructors, and to provide a balance of education and fun.

Goals:

- Engage students in activities that give them opportunities to connect with what they're learning during the day (including cultural history, storytelling, music, and land management).
- Encourage students to think critically about those topics.

VALUES OF THE PAST

At a Glance

Grade Level(s): 6th-8th

Time Required: 60-90 minutes

Materials Needed:
- Values of the Past Historic Figure cards
- Value of the past props & costumes
- Chaperone task cards
- Agree/Disagree cards

Activity Summary: Students will be introduced to historic figures associated to the Pack Forest, Nisqually Basin, and Mount Rainier region and introduced to different ways of valuing the area and dedicating resources to specific goals. By taking on a historic identity, students will develop a greater sense of place and become familiar with local names, cultural history, and values concerning natural resources.

Learning Objectives. Students will be able to…
- take on a historic identity
- apply knowledge of their historic character to think about how we value the land and resources and the choices we make.
- become familiar with historic figures associated with the Pack Forest, Nisqually Basin, and Mount Rainier region.

Vocab Words: land ethic

Details

Background:

Procedure:

1. Instructor asks students to think about who might have lived in this area in the past. Students and instructor discuss the possible groups of people along with where they might have lived and why they were in this area/what they were doing here.
2. Instructor asks students to imagine what it would be like to meet these people and talk to them—what kinds of questions would you have for them, etc. Some possible questions include: What's your name? When did you live? What is your role in your community? What are your values? Who are your friends or people you know? What was your life like?
3. Instructor explains that individuals value land and natural resources in different ways. Explain that one of the challenges we—Pack Forest, Mount Rainier National Park, and society in general through our policy makers—must deal with is how to use land and resources to meet our various needs and to still have it in the future.
4. Instructor asks students to take a minute to think about what the people of the past might have valued about the land and the natural resources. After a minute of think-time (alone or in pairs), instructor asks students to share with the group.
5. Instructor explains that every student will get a Character Card and take on the identity of a historical figure. Explain that the goal is to meet other historical figures, learn why they are important, learn who their friends and acquaintances were, what life experiences they had, and also how they valued the area. Let students know that in the next activity they will make choices based on their character's values.
6. Tell students that they will have 10-15 minutes to learn about their character and become that person and then they will have time to interact with some of the other characters.
7. Once students have learned about their characters, divide them into two groups and help them form two concentric circles. The inside circle should be facing out, the outer circle facing in, so that each student is facing another student.
8. Explain that they are going to have a conversation with the person across from them and use the questions you talked about at the beginning to try and figure out who the person is, if your characters knew each other, what kind of influence the person had, their values, etc.
9. Remind the students to be respectful of their character and other people's characters. This is not a time to fall back on stereotypes about accents or speech patterns that these people may or may not have had. Focus instead on how you think your character would think about different kinds of issues and how they would respond to questions about themself.
10. Explain that every few minutes (2-5, depending on how much time you have for the activity and how big your group is) you will tell them to switch partners and the outside circle will move clockwise to the next person. This part of the activity will be over once each student returns to their starting point.
11. Since no one will have had the chance to meet everyone else, tell students that they will have a few minutes (5-10) to mingle freely with all the other characters and meet people they didn't get a chance to before.
12. Tell students that with the remaining time you're going to say some statements and they will move to different areas of the room depending on what their character would believe. Set one side of the room as the "Agree" side and the opposite side as the "Disagree" side. The middle of the room is the "I don't know" or "Neutral" area.

Tell students that they can find any spot along the Agree-Disagree spectrum, wherever they think their character would fit.

13. Explain that the people who manage Pack Forest and the people who manage Mount Rainier National Park have to make decisions about how to use the land and the resources. Ask students to think about what some of those decisions might be.
14. Explain that people in the past also had to make decisions about how to use land and resources. Say that some of those decisions are similar to what we have today, and that some are different. Add that, in general, we base our decisions on our values and our opinions.
15. Present (some of) the following situations/statements. After all the students have moved to their chosen spot, ask for volunteers to share why their character would have made that choice.
    a. Land should be parceled out for individual ownership
    b. Women are more delicate than men and can't do the dangerous things men do
    c. Lots of roads should be built in Mount Rainier National Park
    d. We need cheap wood products so we should cut down lots of trees here at Pack Forest
    e. Land owners have a right to do whatever they want on their own private property
    f. It's better to be safe and follow the customs of your people
    g. Mount Rainier National Park should be expanded
16. After the last statement, ask the students to think about it again, this time as themselves instead of their character, and move accordingly. Have the students share why they chose the spot they did.
17. Ask students to think silently about how our values and experiences shape our opinions and affect our decisions. Explain that this week they will have many experiences that will help them think about how they value land and resources, and what kinds of choices they make in regards to land and resources.

Learning Context: This is a day 1 evening activity.

Possible Extensions:

Random Roving (a.k.a. Bingo!)

1. Once students have prepped their characters, they are each given a piece of paper with a "bingo" grid. They must meet as many characters as possible and write down a character's name if they fit in one of the boxes.
2. After the students have met as many characters as they can, ask them what they learned about the past from this activity. Ask them to think of a question they still have, or something they wonder about.
3. Example grid (make sure there is a whole page of boxes if you do this activity. This one is just a sample): Find someone who…

Arrived on a wagon train	Climbed to the summit of Mt Rainier	Was Native American	Was a woman
Worked for the Hudson Bay Company	Knew James Longmire	Had a homestead	Etc, etc…

Writing Activity

1. Objectives:
    a. Students will have the opportunity to bring together everything they learned from the activity.
    b. Students will have the chance to synthesize what they learned about history and the ideas they explored about values and decisions about land and resources.
2. Desired Outcomes:
    a. Students will be applying writing skills.
    b. Students will be adding to their Mount Rainier Institute journal, which can be used for a cumulative piece at the end of the unit.

Writing Prompt: What do you now know about history that you didn't know before tonight's activities? How does your new understanding help prepare you for learning about this area?

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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NIGHT HIKE

At a Glance

Grade Level(s): 6th-8th

Time Required:

Materials Needed:
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Activity Summary:

Learning Objectives. Students will be able to…

Vocab Words: Nocturnal. Diurnal. Crepuscular.

Details

Background:

Procedure:

Learning Context:

Possible Extensions:

Adaptations for different learning needs:
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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):
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PREDATOR-PREY GAME

At a Glance

Grade Level(s): 3rd-12th

Time Required: 1 hr

Activity Summary: This a school group wide simulation of the relationships between omnivores, carnivores and herbivores and the adaptations that help them survive.

Materials Needed:
- 6 food stations (poles with markers of different colors attached with one color flagging)
- At least 2 water stations (poles with markers of different colors attached with another color flagging)
- Stomach cards
- Rubber bands
- Two different colors of bandanas
- Soft ball/throwables for hunters (optional)

Learning Objectives. Students will be able to…
- Define herbivore, carnivore, and omnivore.
- Associate different adaptations with those categories of animals.
- Have a better idea of what it takes for an animal to survive in the wild.

Key Words: Carnivore, Omnivore, Herbivore, Predator, Prey, Energy Chain

Details

Background:

Energy Chain-The energy used by life starts with the sun. The sun provides energy that is used by plant producers that go through photosynthesis to create their own food. Primary consumers (or herbivores) then consume the plants. Secondary consumers (carnivores or omnivores) then eat other consumers to gain energy. Finally decomposers break down producers and consumers. Fun fact: decomposers account for 80% of all living animals on earth.

Procedure:

1. **Energy Chain (5 min):** Start with an overview of the Energy Chain, asking students for each step in the chain and having volunteers stand in a line and pass a ball to represent the transfer of energy. This can be embellished with students acting like plants/herbivores/the sun while they transfer the energy.
2. **Game Rules (15 min):** Introduce the game, which is a simulation of relationships between predator and prey animals in the wild. The object of this game is to survive until the end of the game. Students will play the role of herbivore, omnivore or carnivore. Each role has different rules for survival.
    a. **Herbivore:** Must get 4 food marks from different food stations (representing "plant" food), and two watermarks. Start out with 6 lives represented by rubber bands on left wrist.

b. **Omnivore:** Must get 6 food total, either from "plant" food stations or from hunting herbivores. Must also get 2 water. Wear colored bandana around arm to indicate that they are omnivores, and start with 4 life rubber bands on left wrist.
c. **Carnivores:** Must get 8 food represented by hunted omnivores or herbivores. Must also get 2 water and only get 2 life rubber bands to stat with. Carnivores will have a brightly colored armband to identify them.
d. **Hunting:** Omnivores and Carnivores can hunt by tagging another animal. Once tagged the other animal must give them a life rubber band. These count as food and not additional lives. During a rubber band transfer is the only time both animals are immune to being hunted by other animals. Only one rubber band can be collected for each successful tag, and the hunted animal then gets at least a 10 sec head start to get away. Hunters are adult participants who can hunt any animal by throwing a ball and taking rubber bands, excellent job for teachers.
e. **Food/Water collection:** Players collect plant food and water by marking on their stomach card with the attached marker at each station. Players are vulnerable to being tagged while collecting food and water, just like animals in the wild.
f. **Boundaries:** be sure to outline boundaries to include where the food and water stations are hidden as well as giving plenty of cover and open play options. Be sure to indicate a safe zone that the players can come to if hurt or out of lives (usually pavilion). Give students a signal (such as whistle or shout) that will signal the end of the game. If students are out of lives they can be given more by instructor after answering trivia questions or doing a funny dance.

3. **The Game (30-40 minutes):** After rules are said and questions are answered, divide players into animal groups. The ratio is 1 carnivore: 2Omnivores: 7Herbivores. Once selected, have herbivores come up and get their stomach cards and rubber bands. Have the herbivores gather together for last minute questions and boundaries overview as Carnivores and Omnivores are getting their materials. IT helps to have all of this set out beforehand. Herbivores are released first, followed by Omnivores about 2 minutes after, and then Carnivores about 2 minutes after that. While game is in play, monitor boundaries and make sure there is fair play going on. Check in with students as they pass by the pavilion. When it is time for the gam to end signal all players to return, leave all materials on a table and take a seat for wrap up.
4. **Wrap up (5-10 minutes):** Ask students from different animal groups to share what strategies worked best for them in the game. Were they more successful in a group or alone? Were some food and water sources easier to get to than others? How did that affect their survival? Discuss the ways that this game reflects the way wild animals adapt to survive in their habitats.

Learning Context: Currently used as an educational and interactive game for the entire school group to play together. This will help them become more acquainted with each other and Pack Forest, as well as become more aware of the animals that live in Pack Forest and the adaptations they have to survive.

Possible Extensions: Lessons on adaptations of different animals based on diet, also possible energy chain lessons.

Adaptations for different learning needs: While materials are being passed out instructors can explain rules one on one with students that have trouble listening in group settings. Also students can be made hunters in cases where that will help them be able to participate.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

· 6-8 LS2B

- 6-8 LS2C
- 6-8 LS3E

ECOSEL

At a Glance

Grade Level(s): 9th-12th

Time Required:

Materials Needed:

Activity Summary:

Learning Objectives. Students will be able to…

Vocab Words:

Details

Background:

Procedure:

Learning Context:

Possible Extensions:

Adaptations for different learning needs:
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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):
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DATA ANALYSIS - SYMPOSIUM PREP

At a Glance

Grade Level(s): 6th-8th

Time Required: 30-90 minutes

Materials Needed:
- Large whiteboard & dry erase markers
- Student journals
- Data (that your students collected earlier in the day)
- Computer(s) with symposium power point template
- Large poster paper
- Box of markers, crayons, colored pencils
- Yard stick/ruler

Activity Summary: Now that all the data has been collected it's time to analyze the data, form some conclusions about it, and create a presentation.

Learning Objectives. Students will be able to…
- Students will interpret the raw data they collected to form conclusions about what the data means.
- Students will produce a presentation that summarizes their findings.
- Students will critique each other's presentation styles and offer valuable feedback in preparation for their final presentation.

Vocab Words: Symposium.

Details

Background:

Need background on why data analysis is important and what it means…

Some Tips on Facilitating the Data Analysis and Symposium Prep Time

At times, this process can feel like pulling teeth—you and the students are tired after a long day and everyone is in the after dinner energy slump. Try to organize the data analysis and presentation prep so that it doesn't take the whole hour-and-a-half, and/or so that you allow for a 10-minute break somewhere in the middle. Once you get the

hang of it, the analysis and presentation prep should be able to be completed in 30-60 minutes. (Although, of course, some of it always depends upon the specific group.)

It's a good idea to split your trail group into several smaller groups so that each student has a job to do and you don't have half the group sitting around board or goofing off. You can set up the groups in a few different ways: You can do one group each for question-hypothesis, materials-methods, data, results-analysis, conclusions-further questions (5 groups). You can do one group for the first half (question, hypothesis, materials, methods), one group for the last half (results, analysis, conclusions, further questions), and one group to work on showing the data in some type of graph (3 groups). If you're using the power point template that goes by the sections in a scientific paper, you'll have some different titles for the sections (introduction, definitions, materials, methods, data, results, limitations, conclusions), which you can still easily split into three groups. You can also decide to have a group that just works on writing up a script for the presentation so that each person will have something written out for them to say (to avoid looking at the screen and facing away from the audience during the presentation).

Procedure:

RESULTS & ANALYSIS

1. Use the 5-10 minutes before students arrive at your location (classroom, Pack Hall, etc) to draw up on a big whiteboard the data table that the group used in the field. You can leave it blank or write in the numbers, depending on what information you have (i.e. if you wrote down the numbers or if they're all in the student journals) and on the ability of your group.
2. When the students arrive, have them fill out or add to the data table on the whiteboard.
3. Ask the students what they notice about the data—Are there any comparisons they can make, observations, do they think they know why the data looks the way it does, etc.
4. As a group, determine what other information is needed—elevation, definitions, etc.
5. Have the students figure out how to best portray their data to their peers. Do they need to get averages of the data points, make a graph, show the whole data table, etc.
6. Make sure all students are thinking about what their data means and why it matters.

CONCLUSIONS, LIMITATIONS, & FURTHER QUESTIONS

1. Ask the students to look at the data and the extra notes that have been written on the whiteboard. Have them make statements about what the data means. These statements should be backed up by the data they collected.
2. Review the concept of human error. Ask the students if they could have made some mistakes or altered their data during the field study. Remind them that this is ok, normal, and expected to some degree. We're human, and so we make mistakes.
3. Tell them that they didn't do anything wrong and that all scientists make mistakes. The important thing is to write down what mistakes, or errors, we might have made and bring them up during the presentation. Tell the students that we call this section of the presentation "Limitations" or "errors."
4. Have them list the limitations/errors they see in their research. Some examples are not enough test sites, tools or materials that malfunctioned, someone forgetting to write something down, a number getting erased accidentally, etc. Ask your students how these things might have affected their data.
5. Ask the students what questions they have now, after having done this research. If they were to do more field research would their question be more specific? Now that they know more about it, what kinds of follow-up questions do they have?

GETTING READY FOR THE PRESENTATION

1. Divide the students into small groups to work on the presentation. There are several ways you can divide them up. (See "background" section.)
2. Have each group figure out how they're splitting up their section so that everyone has a speaking role.
3. Make sure each person has a write-up of what they're going to say in the presentation.
4. Once all students are done, have them practice their presentation. Tell the students that each group will present their piece while the rest of the groups act as the audience. At the end of each of these mini presentations, the students who were watching will have a chance to give feedback to the presenters. Remind the students that they need to speak loud, slowly, and facing the audience. If any of the students are holding posters or if their scripts are big enough to make noise when rustled, remind them to hold the paper still so it doesn't make noise and distract the audience or their fellow presenters.
5. Make sure each group gets some positive feedback as well as some critical feedback.
6. After all the groups have practiced a few times in front of each other, have them all line up like they will be for the final presentation and have them practice all together for you.
7. On their way out at the end of the evening, be sure to tell them they're doing a great job. It may seem like common sense, but this can really improve moral.

Learning Context: This happens at the end of day 2 or 3 after dinner. Generally it is the same day that your students did their research (not the day they went to Mount Rainier).

Possible Extensions:

Adaptations for different learning needs:

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

OPENING CAMPFIRE

At a Glance

Grade Level(s): 3rd-12th

Time Required: 45min-1.5hrs

Activity Summary: Students participate in a campfire experience. Instructors lead songs, skits, campfire activities, and tell stories, including one important story about cultural history.

Materials Needed:

- Fire materials (firewood, kindling, fire-starter, lighter)
- Fire pan
- Musical instruments (if applicable)

Learning Objectives. Students will be able to…

- Relax, enjoy the campfire experience, and participate in fun instructor-led activities.

- Connect with other students and adults and build community through the campfire experience.
- Recognize and recall characters that are important in the First Ascent story.

Key Words:

Details

Background:

The campfire experience is a very important part of the Mount Rainier Institute curriculum, as a community-building and relaxing end to the day. The opening campfire is a fantastic opportunity to bring in cultural history in the form of the First Ascent story. Additional resources on songs, skits, games, and the First Ascent story should be used in planning the campfire.

Procedure:

1. Prepare the fire pan and fire pit before campfire. In cases of rain, the fire pan can be set up underneath the pavilion instead of inside the fire ring.
2. In the case of a fire ban, candles can be used in place of a campfire.
3. Light the fire before students arrive at campfire, or as students begin to fill in.
4. The content of the opening campfire is very flexible (see songs, games, and skits section), but this general outline is usually helpful:
5. Begin with a high-energy attention-getter. The first half or so of the campfire should consist of fun songs, skits, and activities.
6. Bring the energy down with the First Ascent Story.
7. Finish with a quiet closing activity or a quiet song.

Learning Context: This campfire is done on the first night. The purpose is to get students comfortable in their environment, gain a sense of place through cultural history, and enjoy the outdoors.

Possible Extensions: It is always possible to extend this campfire through more activities.

Adaptations for different learning needs: For older students (high school-aged), it is important to let the students have some more "chill time" around the campfire. Some of the campfire activities and stories can still be done, but it should be less structured and more relaxed for this age group.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

CLOSING CAMPFIRE

At a Glance

Grade Level(s): 3rd-12th

Time Required: 45min-1.5hrs

Activity Summary: Students participate in a campfire experience. Instructors lead songs, skits, campfire activities, and tell stories. S'mores are roasted at the beginning of this campfire.

Materials Needed: Fire materials (firewood, kindling, fire-starter, lighter), fire pan, musical instruments (if applicable), S'more sticks and S'more materials.

Learning Objectives. Students will be able to…

- Relax, enjoy the campfire experience, and participate in fun instructor-led activities.
- Connect with other students and adults and build community through the campfire experience.
- Reflect on their experience at Mount Rainier Institute.

Key Words:

Details

Background:

The campfire experience is a very important part of the Mount Rainier Institute curriculum, as a community-building and relaxing end to student's days. The closing campfire is a great time to continue building community, and to encourage students to reflect on their time at Mount Rainier Institute. Additional resources on songs, skits, games, and stories should be used in planning the campfire.

Procedure:

1. Prepare the fire pan and fire pit before campfire. In cases of rain, the fire pan can be set up underneath the pavilion instead of inside the fire ring.
2. In the case of a fire ban, candles can be used in place of a campfire.
3. Light the fire before students arrive at campfire, or as students begin to fill in.
4. The closing campfire begins with S'more roasting. The kitchen staff provide us with chocolate-covered graham crackers and marshmallows, usually left inside Pack Hall. These materials should be set up on a table (NOT a picnic table, set it up slightly away from the fire ring). Enlist chaperones and instructors to assist with S'more roasting. One adult should be monitoring students around the fire to make sure they are staying safe. One adult is responsible for putting marshmallows on the marshmallow sticks. Another adult is responsible for taking

roasted marshmallows putting them between two chocolate-covered graham crackers. If there are students with food allergies, make sure to avoid cross-contamination during the S'more process.

5. Dismiss students in small groups to line up to get their stick with marshmallow. Ensure that students are not waving flaming marshmallows around in the air. When they are finished with their marshmallow, they may come back to the table, place their marshmallow on top of a chocolate-covered graham cracker, and the adult will help by placing another graham cracker on top while the student pulls the stick out of the S'more. The student should then calmly hand their marshmallow stick to the adult in charge of putting the marshmallows on sticks before picking up their S'more.
6. This process should be continued until all students that want to make a S'more have a chance to do so.
7. Once S'more roasting is complete, instructors can lead campfire in a similar format as the opening campfire.
8. Begin with high energy activities and songs and bring the level down with a story or quiet activity.
9. Finish with a quiet closing activity or a quiet song. If instructors are comfortable, the Mount Rainier Institute Song (Mother of Waters) is an excellent closing.

Learning Context: This campfire is done on the last night. The purpose is to get students to continue building community and reflect on their time at Mount Rainier Institute.

Possible Extensions: It is always possible to extend this campfire through more activities.

Adaptations for different learning needs: For older students (high school-aged), it is important to let the students have some more "chill time" around the campfire. Some of the campfire activities and stories can still be done, but it should be less structured and more relaxed for this age group.

EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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Appendix A – Extra/Alternative Lesson Plans

- Day 1: Wrap Up
- Comparative Field Science Investigation
- Exploring the Volcano Through the Mineral Springs
- Protect or Provide
- Each One Teach One

Day 1: Wrap-up

Objectives

Students summarize what they have learned about the different Nature's Benefits and create posters or banners that represent the different types of benefits.

Estimated Time & Location

30 minutes. The Welcome Shelter, a classroom or, porch.

Materials

Nature's Benefits Cards (from the introductory Activity)

Poster Paper

Markers and Art Supplies

Procedure

1. Once back near Pack Hall, find a comfortable place where students can work: the Welcome Shelter, Pack or Scott Hall or on one the porches work well.
2. Review with students the three Nature's Benefits that they explored today: Economic, Ecological, and Cultural.
3. Divide the trail group into three working groups and pass out poster paper and art supplies.
4. Assign one of the benefits to each group and tell students that in their group they will need to come up with a symbol for their benefit. Have them draw the symbol on their poster paper and decorate the poster.
5. Give the student 15 minutes or so to develop their poster. Next take out the cards form the introductory activity. Go through each card with the group and ask them to see if it fits on one of the posters. This is a sorting activity, but note that a benefit on the card may fit into more than one category. That's OK.
6. End by emphasizing that we, as humans, benefit tremendously from nature. Places like Pack Forest and Mount Rainier National Park have been set aside specifically to provide us with those benefits.

COMPARATIVE FIELD SCIENCE INVESTIGATION

At a Glance

Grade Level(s): 6th-8th

Time Required:

Materials Needed:
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Activity Summary:

This is a structured inquiry in which students will conduct a comparative field science investigation to determine how the forests change over time. There are many questions that could emerge in comparing old vs. young forest. Potential variables include tree density, tree diameter, ground cover, etc. The primary goal of this day is not necessarily to learn forest ecology (though they likely will) but rather to learn and practices science process skills by conducting a complete investigation all in one day.

Students will use their observations to develop a research question and a hypothesis (note for younger student or because of time instructors may have to structure the investigation by giving the students a question). They will then discuss methods and collect data. They will analyze their data, draw conclusions, and develop their theories for why they think they got the results they did. Last, they will develop a research presentation to give at the science symposium.

Learning Objectives. Students will be able to…
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Vocab Words:

Details

Background:

Essential Question

Pack Forest is developing a management plan and needs to know more about its forests.

In particular, Pack Forest is wondering more about the impact of potential future timber sales on wildlife and plant biodiversity. When timber is cut, and then replanted, it become a "new" forest. So Pack Forest wants to know about how young forests differ from older forests. Our essential question is What are the differences between old and young forests?

Potential Research Questions

Wildlife

- Are there more snags in old or young forests?
- Is there more bird activity in old or young forests?
- Are there more soil insects in old or young forests?
- Are there more Animal signs (non-insects) in old or young forests?
- Is the air temperature higher in older forests?

Plants

- Is there more tree and understory diversity in an old or a young forest?
- Is there more lichen in an old or young forest?
- Is there more ground plant diversity in old or young forests?
- Is soil temperature higher in older forests?
- Is there more canopy cover on old or young forests?

Procedure:

1.

Learning Context:

Possible Extensions:

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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EXPLORING THE VOLCANO THROUGH THE MINERAL SPRINGS

At a Glance

Grade Level(s): 6th-8th

Time Required: 1.5-2 hours

Activity Summary: This activity is set at Longmire, on the Trail of the Shadows. It is important for the students to have some prior knowledge or basic understanding of plate tectonics. This cannot be done if there is much snow on the ground. The most important consideration would be if the various springs are accessible and can be reached.

Materials Needed:

- Images of subduction, plate boundaries map, Mt. Rainier, gas emissions from craters, melting snow on craters
- Pictures of what the travertine mounds used to look like
- Graphs of average temperatures
- Plastic water bottle
- 7 in. balloon
- Thermometers
- Tape measure
- Student journal and pencil/pen
- Rope

Learning Objectives. Students will be able to…

- Students will be able to list and describe the 3 major types of plate boundaries
- Students will be able to describe subduction
- Students will be able to describe the role gases play in volcanic eruptions
- Students will be able to be able to describe why the springs at Longmire are warm
- Students will be able to explain why the springs are bubbling

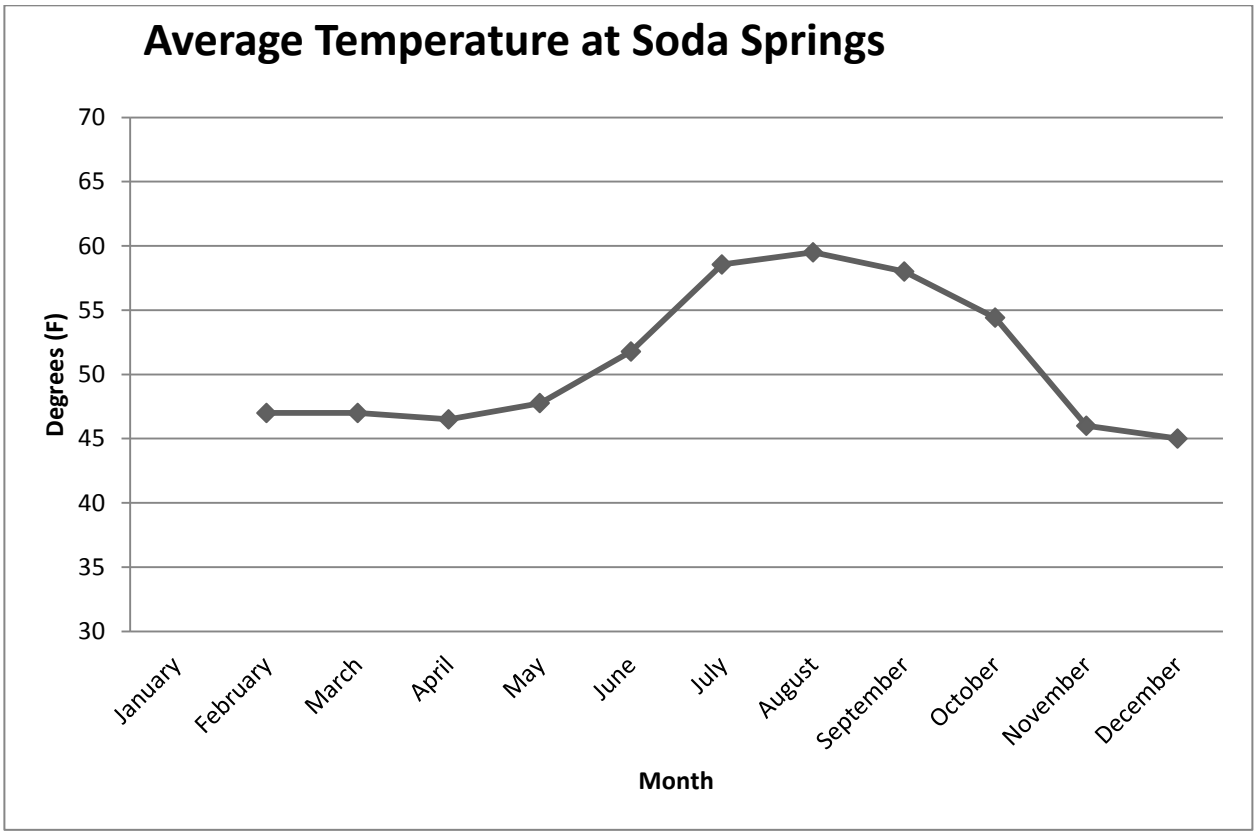
Key Words:

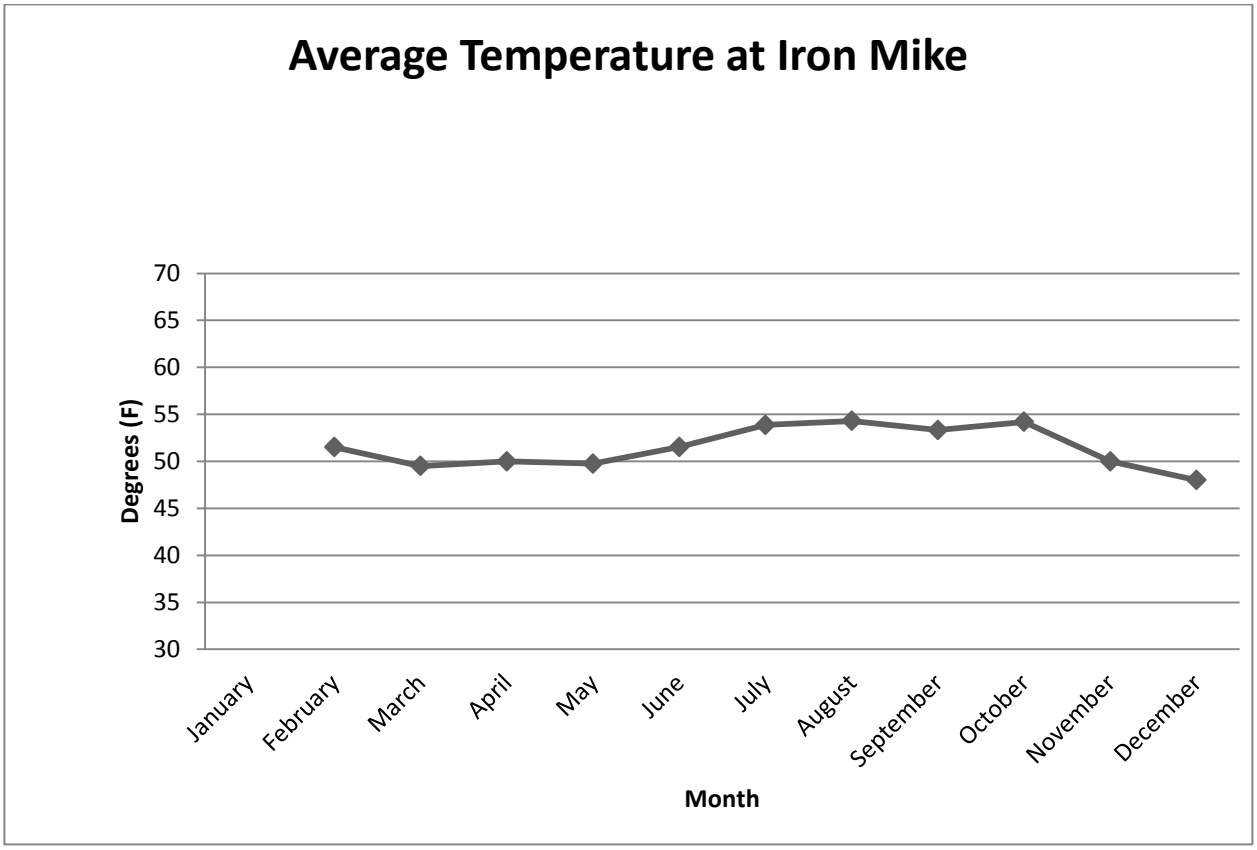
Details

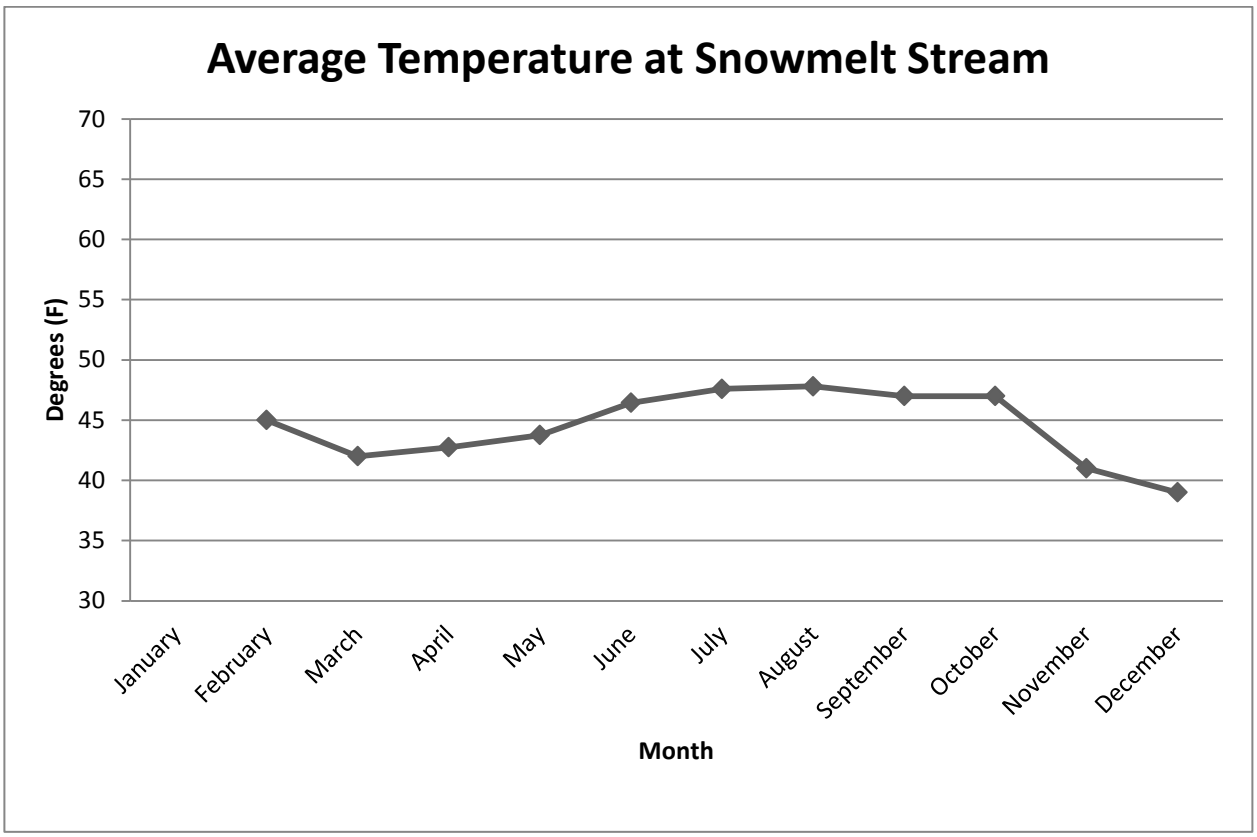
Background:

Longmire Springs

The Longmire Springs are a system of mineral springs. The springs were discovered by James Longmire in 1883 and he returned in 1884 with his family to "Longmire's Mineral Springs" resort. They believed and advertised that the springs had medicine in them that would cure any and all ailments. As of today we know that the water studies show a mix of iron, magnesium, carbon dioxide, sodium chloride, and traces of other minerals, including arsenic. The springs are created by water from rain or snow saturating the ground upslope of the springs. The water travels underground becoming infused with hot gas from the volcanic system below ground. The water becomes mineral saturated as it travels down slope as ground water. It resurfaces at the various springs, releasing carbon dioxide, which creates the bubbling.




Average Temperature at Iron Mike
70
65
60
55
50
45
40
35
30
Degrees (F)
January
February
March
April
May
June
July
August
September
October
November
December
Month


Average Temperature at Snowmelt Stream
70
65
60
55
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Degrees (F)
January
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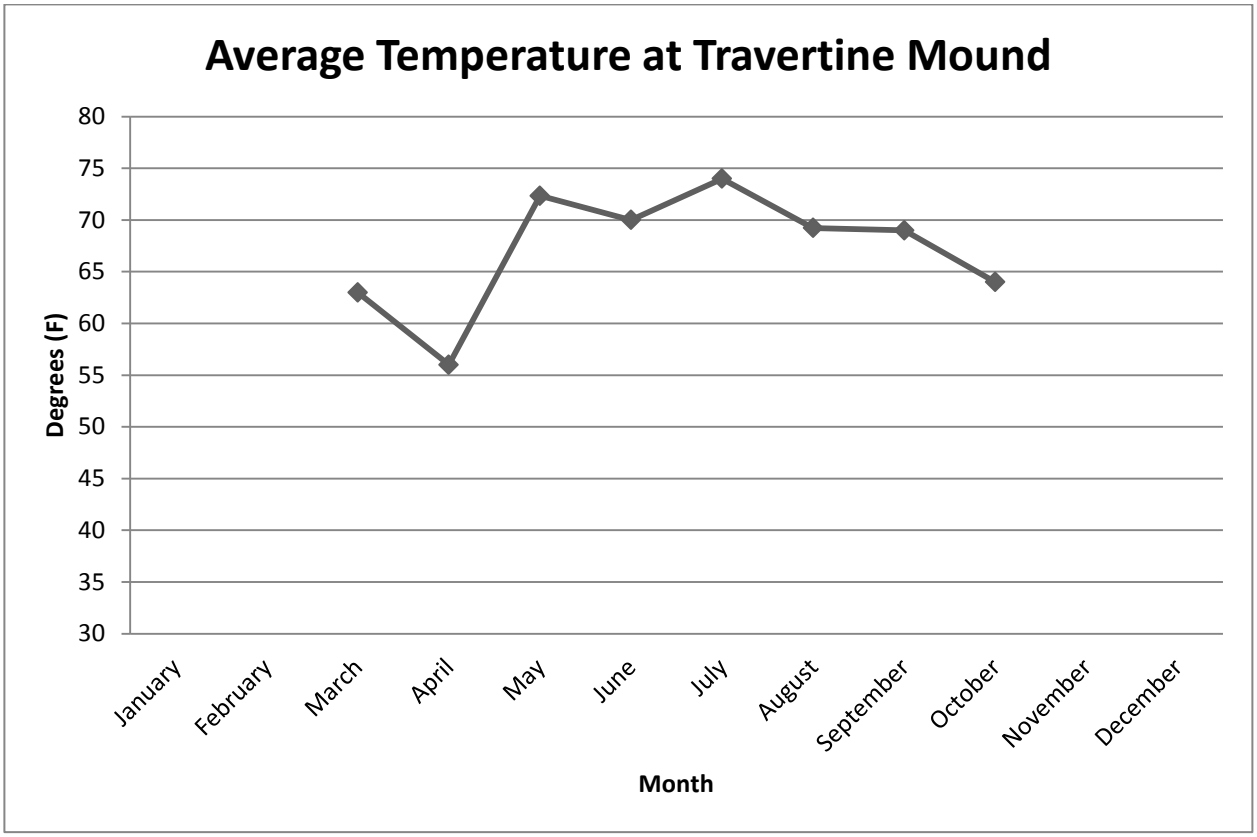

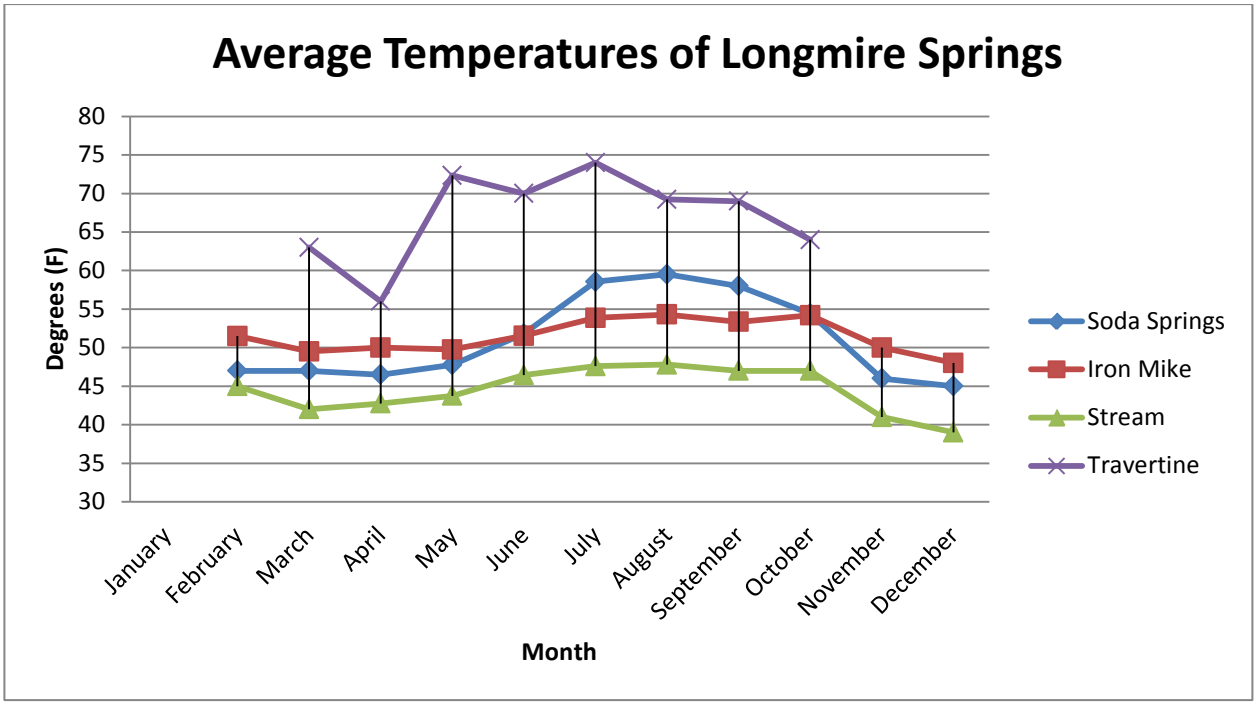

Travertine Mounds

Travertine is a sedimentary rock and is a form of limestone, which is typically deposited by mineral springs. This rock is created by calcium carbonate, or carbonate minerals, precipitating out of the water at the mouth of the hot springs. The carbonates precipitate and become minerals when waters degas, or release, CO2. We see

this 'degassing' occurring from the bubbling happening at this spring. A theory (no resources to back this up), but I think that the only reason we see travertine forming at this location and not at the other springs, is because of the warmer temperatures. Therefore, it is due to the warmer temperatures and the release of CO2 at this spring, which allows for the travertine to form. It is also important to note that the travertine mounds used to be much larger, but are almost non-existent today (this is due to human impacts in the area).

Iron Mike

There are significant iron deposits, specifically at the Iron Mike spring. The water at Iron Mike has dissolved iron in it. When iron is dissolved in water the water will still appear clear, which is what we see from the water bubbling in the spring. When this water hits the air (goes from an anaerobic to aerobic environment) the iron becomes oxidized and turns the rusty orange color. However, at Iron Mike iron bacteria is present, which is the slimly orange that you see everywhere. This bacterium derives its energy to live and multiply by oxidizing the dissolved iron, creating the orange slime by-product that we see. The bacteria thrives in areas where water goes from an anaerobic (without oxygen) to aerobic (with oxygen), which is exactly what is happening at this spring. The iron bacterium does not pose any health risks, but may stain clothing.

Earth Caching

Earth Caching is related to Geocaching, where people look up coordinates online and then use a gaps to find a cache box. This is essentially a large scavenger hunt. EarthCaching directs people more toward natural features, and often has some sort of science attached to it. There is an EarthCache set up for taking the temperature at the Longmire Mineral Springs. EarthCachers will go to the Longmire museum and ask for the dictionary, where they will find a log book, directions, and a thermometer. The data that has been used in this program is taken from that log. As of right now that data is currently not being used. However, it is possible that it may become a part of the citizen science program and used for baseline temperatures at the springs. If the data is going to be used, then it will be important to use the appropriate type of thermometer and follow particular protocols. Please talk to Kevin Bacher for more information. He may also want the data that you collect with students.

Plate Tectonics

(Excerpts taken from the "Surrounded by Volcanoes" lesson from the 'Living with a Volcano in Your Backyard: An Educator's Guide with an emphasis on Mount Rainier' curriculum from the USGS.)

- Tectonic Overview:
    - Earth's lithosphere is fragmented into more than a dozen tectonic plates that glide across the soft mantle of the Earth like carefully choreographed dancers. Some plates glide past each other horizontally as transform plate boundaries. Other plates dance away from one another, as divergent plate boundaries. Some plates move toward each other and meet at convergent plate boundaries. The distribution of earthquakes and volcanoes on the Earth reveals the boundaries of these plates. In the same way, knowledge about plate boundaries helps scientists understand the potential for earthquakes and volcanoes around the world.
- Plate Boundaries:
    - Divergent- About seventy-five percent of Earth's volcanism occurs sight unseen at the ocean bottom, where plates pull apart along divergent plate boundaries. Magma rises in the gap between the separating plates and erupts–building volcanoes as a spreading ridge on the sea floor. A well-known

illustration is the spreading ridge of volcanoes along the Mid–Atlantic Ridge, which pulls apart at a rate of about 2.5 cm/year (1 inch/year) and which rises above sea level as Iceland.
    - Convergent- Converging tectonic plates are frequently of different densities. While both plates are in motion, commonly the denser plate moves beneath the other in a process known as subduction. The grinding together of these plates generates a tremendous stress that causes the subducting plate to crack, fracture and shake. Thus, the pattern of earthquakes delineates the position of the subducting slab. Approximately 400 kilometers (250 miles) in depth, temperature and pressure are so high that the subducting plate ultimately loses physical identity and continuing movement fails to produce earthquakes.
    - Transform- At transform faults, plates slide past one another horizontally and produce earthquakes, though rarely cause volcanoes. The San Andreas Fault Zone in California, where the Pacific Plate slides past the North American Plate at a rate of 5 centimeters (2 inches) per year, is one of the best known examples of a transform plate boundary. In the Pacific Northwest, a transform plate boundary separates the Juan de Fuca Plate on the north side from the Pacific Plate on the south side.
- Subduction of the Juan de Fuca Plate
    - The Juan de Fuca Plate consists of dense oceanic plate rock that is relatively thin compared to most of the North American Plate. The Juan de Fuca Plate originates as a slab of hot volcanic rock at the spreading ridge. As it moves eastward, it cools, becomes denser and sinks into asthenosphere, the soft, highly viscous rock of the upper mantle beneath the western edge of the North American Plate. Eventually, temperatures are hot enough to break down water-bearing minerals within the sinking Juan de Fuca Plate. Water is released into the overlying mantle, where it lowers the melting temperature of rock and causes the mantle rock to melt. By this complex combination of physical and chemical processes, magma forms. The upward movement of magma, caused by magma being less dense than surrounding solid rocks, also forces melting of crustal rocks and the formation of magma chambers that feed Cascade volcanoes.

Other Information

- The graphs can be updated and found on the G drive/Education/Program Outlines and Activities/ 2011 Lesson Plans
    - There is an Excel Page, which has all the data from each spring and can be revised at any time. Each graph has been copied into a word document and then saved as a PDF
- Kevin Bacher started an Earth Caching program to measure the temperature of the springs. This data was taken from that log book, which can be found in the Longmire Museum. The data runs from May 2009 through the present.
- Note on Data: These graphs were created by compiling all of the data throughout the years. Some of the months only had one or two entries, so it is likely not the most accurate.
- If you have any questions regarding the Earth Caching please direct them to Kevin.

Procedure:

Introduction

1. Introduce students to the Park and the Rangers.
2. NPS Introduction
3. Tell students that today we are going to be scientists. What do scientists do? *Explore, observe, and investigate.*
4. What makes Mount Rainier special and unique?

STOP 1: Tectonic Fundamentals

1. Today we are going to be looking at one of the most fascinating geologic processes. Volcanoes!! We will also be able to see some evidence that we are near a volcano and think about how the volcano formed. How do volcanoes form?
2. The earth is made up of tectonic plates that slowly move around the world (millimeters to centimeters every year). Show map of tectonic plates.
3. Does anyone know what happens at the border between two tectonic plates?
   a. Divergent: The plates are moving away from each other. Examples are Mid-Ocean ridges where the plates are being pulled apart. Show motion to demonstrate
   b. Transform: Two plates are sliding and grinding past each other. Examples are the Pacific Plate and North American Plate along the San Andreas Fault. This motion creates earthquakes. Show motion to demonstrate
   c. Convergent: Two plates collide with each other. Either they will crumple and create mountains, like the Himalayan Mountains, or one will subduct. Subduction is one plate sliding below another plate. This action creates volcanic eruptions Show image of subduction and motion to go along with it.
4. Play Game—This game is similar to 'Zippity Do Da' or 'Bob'. The group makes a circle with one person in the center. The person stands in the center and will spin around and randomly point to someone in the circle and say one of the types of plate boundaries. The people on either side of the person who was pointed at have to do the appropriate action, or else they are out and become the person in the center of the circle.
   a. Divergent- Students on either side have their arms out around the person in the center and then pull their arms back towards them. The person in the center has to act like they are erupting, because lava comes out at this boundary.
   b. Convergent Collision- The person in the center ducks down and the people on either side face each other and reach their hands up together, like a mountain.
   c. Transform- The students on either side of the person have to shake back and forth and the person in the middle has to flail and yell 'earthquake!'
   d. Subduction- The students on either side hold hands and the person in the middle has to duck down and crawl under their hands, like a plate subducting, and then jump up and yell eruption once they have made it through.
   e. Check for understanding and ask students why they are doing each action to represent specific plate boundaries.

STOP 2: Soda Springs

THE BUBBLES and VOLCANIC ERUPTIONS:

1. How was Mount Rainier created? By which type of plate movement? What happens when a plate subducts? *The plate that is subducting melts.* What is the plate made of? What happens when it melts? *The plate is made of rock formed in the middle of the ocean. As it dives deeper into the earth the temperature and pressure cause a lot of water to be released from the rocks.* What do you think happens to the water when it is released into the center of the earth? The water is at an extremely high temperature, so what state would it be in? *At this point water is a gas*. What do you think would happen as more and more gas collects inside the earth? *The pressure will build up, eventually causing a volcanic eruption.*
2. Show images of volcanic craters and summits with gas escaping and relate to the idea of gas release. Also have images where this gas is causing melting of snow to show how much heat is being released. Monitoring gas emissions is an extremely important part of monitoring volcanoes to determine if there will be a volcanic eruption.

3. Who sees some evidence of gas near us? What do you think the bubbles are made of? Why is there bubbling here. *These bubbles are made of carbon dioxide.* What is something that you have had that has bubbles similar to this? *Soda.*
4. Let's pretend that this water bottle represents the magma chamber deep within the earth. Now let's fill that magma chamber with some magma, which in this case is water. Put a balloon over the mouth of the water bottle. This is also meant to represent the inside of the earth/ magma chamber.
5. Ask students what they think will happen to the balloon once the bottle is shaken. As you shake the bottle make sure you hold the balloon on so that it doesn't fall off.
6. Ask the students what happened and what they observed. All of the CO2 in the water is released to fill the balloon.
7. We have trapped this gas within the balloon. Do you think that this is similar to what happens inside the earth? It is true that shaking isn't happening but as subduction continues to occur there is an increase in the amount of gas over time. What do you think would happen if you collected more and more gas within the balloon over time? *It would probably pop or burst*. What would happen if all of this gas was left trapped inside the earth? This can be related to volcanic eruptions, which occur from the buildup of gas and pressure within the earth. Eventually the pressure becomes so great that the gas and magma will force itself out of the earth, causing an eruption.

TEMPERATURE EXPERIMENT:

1. We are going to do an investigation of all of the water that is available in this area. Where is the water coming from? *Underground. Rain and snow saturate the ground and then travel underground (as ground water). The water is resurfacing at this location.* What do you notice about the water? These were advertised as mineral hot springs, which would cure any and all ailments. Would you want to drink this water? Don't let students drink the water.
2. Just looking at the water do you think it is hot or cold? Have students make a prediction/ hypothesis about what temperature the water is going to be. What is their hypothesis based on? You can also relate that their hypothesis is probably changing based on the new information they gather at each stop. A hypothesis is an educated guess and we can see how our guesses change with the more information that is available.
3. Demonstrate how to take the temperature of the water, and then have students perform the measurement. Have them do multiple trials in order to make sure we get the best possible answer. What factors may influence the temp of the water today? Time of year- relate to ground temperature, and snow melt, etc. Have a recorder write down the average temperature.
4. Have a graph of the temperature of the springs throughout the year. Explain how to read the graph and what each axis and the line represents. Have them think about why it might change over the course of the year. Is the temperature they got today close to the average temperature during this month?

WATER LEVEL:

1. Another activity that can be done at this location is to look at the height of the water in the spring. This can be measured by using a tape measure and measuring from the same location at the top of the spring. It appears that the water level changes drastically over the course of the year. Why do you think this happens? *Discuss the idea of water availability throughout the course of the year.*
2. Where is the water coming from? Is there snow on the ground? Is it melting?

STOP 3: Iron Mike

TEMPERATURE EXPERIMENT

1. Repeat the processes from soda springs to take the temperature at Iron Mike, including the idea of making a hypothesis about whether it will be warmer or cooler than soda springs. You can also relate that their hypothesis is probably changing based on the new information they gather at each stop.

2. Look at the relevant graph
3. Have students smear iron on their face as a celebration in honor of this special environment with mineral springs that are associated with Mount Rainier, etc.
    a. Note: The reddish slime present at Iron Mike is iron bacteria. This organism feeds on iron that is dissolved within the water. Iron is dissolved within the ground water here and becomes oxygenated when it reaches the surface (going from an anaerobic to aerobic environment). The bacteria thrives here because it is able to derive its energy from the dissolved iron. The result is the reddish orange color and the associated slime.
4. Take the temperature of the snowmelt stream using the same processes as before. What is different about the stream as compared to the springs? Where is this water coming from? Why is it cooler than the springs? *This water is supplied directly from snowmelt upslope.*

STOP 4: Travertine Mounds

1. Repeat the process from before with hypothesis, testing, recording, and looking at the graph.
2. Make sure to note that this is a very sensitive area and that we don't want to go off of the boardwalk.
3. What is different about this area and this spring as compared to iron mike and soda springs? *This area has travertine that has been deposited. Travertine is a sedimentary rock, which forms in areas which are geothermally heated. It is created from the carbonates (minerals) coming out of the water and slowly being deposited.* Based on the temperature here and other observations, why do you think we have travertine here and not at the other locations? *It is possible that this spring is fed from a different hydrothermal source and there are different minerals, and that it is warmer than the other springs.*
4. Show a picture of what the travertine mound used to look like. Where did all the travertine go? *The mounds used to be much larger, but have essentially been destroyed by various human impacts.*

STOP 5: Stream under Bridge

1. Where do you think that this water is coming from? *This is essentially the same stream that we measured flowing into the meadow. It flowed through the meadow past where we have been walking.*
2. Have students predict whether the temperature will be warmer, cooler, or about the same as when it entered the meadow. Make a hypothesis. Test the water.
3. There is currently no previous data about temperatures of this stream. However, it appears that it is significantly warmer than when it entered into the meadow. Are you surprised by how much warmer it is? Why do you think this is happening? *The water may have been warmed by the sun, but more importantly it has mixed in with the geothermal groundwater along the way, giving it a much higher temperature.*

STOP 6: Forest Stop

DISCUSSION:

1. Have students sit in a circle. Look at all of the graphs.
2. Ask students what they observed at each location. Look at the graph that shows all four locations and compares that average temperature. What do you notice overall? Why would some areas be warmer than others? (It usually is found that the travertine springs have the highest temperature.)
3. Have students discuss possibilities of why one area would be warmer than the other areas. This is likely based upon where the source of heat is coming from in relation to where the springs are. The water is heated through geothermal heat from cracks and vents inside the earth.
4. Show an image to explain why and how these cracks and areas are heated through cracks and vents inside the earth. You can also look at the difference between the springs and the stream running into the meadow at the

bridge by the cabin. This water is significantly cooler because it is from the snow melt and has not come from underground.

5. Why is it important to study water and water temperature? What do we use water for? *Drinking, health, plants, animals, etc. A necessity for all life*
6. This project of taking and recording the temperature of all of the springs is a part of a larger project. This is an Earth Caching site, which is like a big scavenger hunt. People look up these sites on the internet. When they get here they are able to get a log book and a thermometer and take the temperature of all of the springs. This is where all of our graphs and data have come from, is people just like you coming to take the temperatures for fun. The data that you collected today will also be used in the future. It is then possible that the park scientists can use this data for future research.
7. How does this relate to volcanoes and volcanic eruptions? *It shows that there is heat from inside the earth that is being transferred to the surface. The springs also show that there is gas that is present within the area.* This is an extremely important connection to make to understand why volcanic eruptions occur.
8. Is it a good sign to have gas and heat that is escaping from the earth? What would happen if we didn't see any gas escaping? Do you think that there is more gas that is being released up near the crater? *It is important to see gas released because then it is not being built up inside the earth, like the balloon. It is also important to continue monitoring the gas because we can see a base level, and if we see an increase or a decrease, it could be an indicator that something is happening inside the volcano.*

Conclusion

Thank the students for coming. Ask them what their favorite part of the day was. Encourage them to keep explore and to come back to the park to explore some more.

Learning Context:

Possible Extensions:

Assessment—True or False Tag (need open space)

1. Prior to teaching the rules have boundary lines established and well marked. Mark off a playing field of approximately 10 large paces wide X 30 large paces wide (this area can be adjusted to compensate for student "antsy pants" and the number of players). Each end of the playing area is a "Safe Answer Zone".
2. Establish the center of play area. This is the Question line.
3. Divide students into two teams, place each team on opposite sides of the Question Line.
4. Establish the True Team and the False Team.
5. Direct students attention to the boundary line behind each team. These are the answer zones-true and false, respectively.
6. Students will be read a statement based on what they learned today.
7. If the answer to the question is true, the True Team runs back to their (true) answer zone.
8. If the answer to the question is false, the False Team runs back to their (false) answer zone.
9. The object of the game is to tag, and therefore capture, the opposite team member before they get to their Answer Zone, thus increasing their respective team sizes.
   Example: If the answer to the question is false; false players run to their answer zone, but a false player is tagged by a true player. The tagged and captured false player then becomes a member of the true team and conversely, a true player running to their answer zone, is tagged and then becomes a false team member.
10. Play the game as long as time permits or until one team has all of the students. The winning team has the most players at the end.

Statement Examples:
The snowmelt stream had the highest temperature today. *False*
Mount Rainier was created by subduction. *True*
Gas is one of the factors that causes a volcanic eruption. *True*
The travertine mounds had the lowest temperatures. *False*
The temperature of the springs varies throughout the year. *True*

Other Assessment ideas: Ask specific qualitative questions about the program

Adaptations for different learning needs:

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EALRs Addressed:

- EALR 2: Inquiry
  - 6-8 INQB - Different kinds of questions suggest different kinds of scientific investigations
  - 6-8 INQC - Collecting, analyzing, and displaying data are essential aspects of investigations
  - 6-8 INQE - Models are used to represent objects, events, systems, and processes. Models can be used to test hypotheses and understand phenomena, but they have limitations.
- EALR 4: Earth and Space Science
  - 6-8 ES2D - Water is a solvent. As it passes through the water cycle, it dissolves minerals and gases and carriers them to the ocean.
  - 6-8 ES2F - The crust is composed of huge crustal plates on the scale of continents and oceans which move centimeters per year, pushed by convection in the upper mantle, causing earthquakes, volcanoes, and mountains.

(Lesson developed by Chelsea Neill 2011 Geologist-in-Park)

PROTECT OR PROVIDE

At a Glance

Grade Level(s): 7th-12th

Time Required: 20 minutes

Activity Summary: Students evaluate actions as whether that action protects the resource and/or provides enjoyment for visitors. Students try to balance these decisions using the ruler and laminated cards.

Materials Needed:
- Protect/Enjoy ruler
- Purple laminated cards with paper clip and rubber band

Learning Objectives. Students will be able to…
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Key Words:

Details

Background:

Procedure:

1. Pass out the rulers to each group (of at least 2 people). Most students will have some knowledge of fulcrums, balancing, and levers. Challenge each group to balance the ruler on one group member's finger.
2. Hand out the laminated cards with rubber bands. Read an action (below). If students think that the action protects the resource, they will hang a card on the "Protect" side of the ruler. If they think the action provides enjoyment for visitors, they will hang the card on the "Enjoy" side of the ruler. Then, after each statement is read and cards are added, the students should try to balance the ruler again.
    a. Possible questions: Which side did the group choose? Is their finger now closer to the "Protect" or "Enjoy" side of the ruler?
3. Debrief: Was it easy or difficult to balance protecting and enjoying the park? Why? Can decisions and actions both protect resources but also provide for enjoyment?

Actions to be read:

- There isn't enough parking at Paradise, and people park wherever they can find an empty space. Sometimes this means that people park on the meadows. The park decides to build a parking lot to accommodate more cars.
- The park has a policy that visitors must not feed the animals.
- The park builds a trail through the forest.
- It is park policy that when the parking lot is full at Sunrise, cars must wait until other cars exit the park before entering.
- Backpackers who camp while hiking must camp in a designated campsite near the trail.
- At Paradise, it takes less than 15 footsteps to kill a plant. It is policy that visitors must stay on the trail.
- A visitor finds a beautiful flower. She stops and takes a picture of the flower, not picking it.
- A visitor picks up litter that they find.
- Visitors come to the park to go sledding.
- The park has put locked gates on caves around the park, so that visitors cannot enter and spread an infectious and quick spreading disease to bats.
- The park plows the road to Paradise in the winter.
- A visitor writes to their Congressman about why they value Mount Rainier National Park.

Learning Context: This activity is best done after introducing the mission of the National Park Service.

Possible Extensions:

Some students may immediately say that an action both protects and provides for enjoyment. These groups can put at least one card on each side and another card on the side they think is mainly guiding the action.

For example: "There isn't enough parking at Paradise, and people park wherever they can find an empty space. Sometimes this means that people park on the meadows. The park decides to build a parking lot to accommodate more cars." Some students may say that the decision to build a parking lot provides the opportunity for visitors to enjoy the park but also helps protect the park resources by providing more designated spaces for parking, instead of cars parking on the meadow (even though constructing the parking lot would damage resources). This group could put 2 cards on the "Enjoy" side and one card on the "Protect" side.

Adaptations for different learning needs:

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EALRs Addressed (Search for keywords in EALRs online at http://standards.ospi.k12.wa.us/Default.aspx):

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Based off the Mammoth Caves Activity (pg. 17):
http://www.nps.gov/maca/forteachers/upload/Curriculum_Guide_6-8_2003.pdf