What Were We Zinc-ing?

Introduction

We are a group of students from the College of Education. Learning through Inquiry is a very popular teaching method in today's world of education. However, none of us have had much experience learning this way and we found it difficult to apply in our own classrooms. We wanted to perform an experiment at the Canadian Light Source(CLS) to experience the Inquiry Method first hand so that we can successfully incorporate this method into our teaching practice.

We wanted to learn about our local environment and its history. A dendrochronologist convinced us that this could be possible by analyzing tree core samples because tree rings tell us information over a timeline. We chose to analyze tree core samples from Asquith and Midale, SK, because they have different climates but are in the same soil zone. Our main interest was investigating how trees respond to droughts. So, we performed an experiment using tree samples from two different locations to measure the chemical composition of tree rings in and around drought years.

Hypothesis

Manganese is a vital mineral for photosynthesis in plants. During droughts, trees cannot collect enough minerals from the soil because there is less water to carry it. We chose to investigate manganese(Mn) because this is an element found deeper in the soil and we thought this might lead to a greater difference in Mn levels absorbed by the trees in drought years relative to healthy years. In drought years, we assumed that trees would drive their roots deeper in the soil to obtain water from a lower water table. By collecting photon counts of Mn and various other elements in spruce tree samples during major drought years (1963, 1988, 2001), we expected to see a greater relative level of Mn in drought years than in healthy years. We also expected to see higher levels of Mn in Southern spruce trees than in Northern spruce trees due to a general hotter and dryer climate.

Procedure

Using the IDEAS Beamline at the CLS in Saskatoon, we were able to measure the amount of Mn present in our spruce tree samples. We soon realized that Mn counts were very low in both the Asquith and Midale locations, even during drought years. So, we performed a Line Scan on our sample to see if there might be Mn visible in the years between droughts. We did not find any significant amounts of Mn, but we did discover 2-3 prominent peaks in Zinc (Zn) levels in both of our samples. This steered us away from Mn and towards Zn instead.

Data Analysis & Results

We postulated that higher levels of Zn might correlate with drought years in the province because the peaks in Zn show a similar pattern in both the Asquith and Midale samples. As seen in figures 6 and 7, the peaks appeared *before* the droughts in some cases and *after* them in others. We then researched and graphed seasonal temperature and precipitation data records from Saskatoon and Estevan to see if there were any correlations, but found no clear evidence.

Based on scientific literature, deficiencies in Zinc are often caused by cold winters and poor soil conditions. If temperatures were warmer during the winter months, this would theoretically result in greater Zinc uptake, meaning the correlation seen between Zinc and warmer winters could be a plausible explanation for our data.

Conclusion

While at first discouraged by the dead end that manganese proved to be, our experiment still proved to be useful through our discovery of prominent Zinc spikes in the wood sample. We did not see a relationship between high levels of Zinc and droughts, precipitation or temperature as theorized, forcing the experiment to be revised yet again. However, through further inquiry and literature research, it was found that winter conditions can have an effect on Zinc uptake in White Spruce trees.

Future Research

Zinc is a necessary nutrient that regulates the life of a tree, however coniferous trees need very little of it. Zinc helps digest proteins and is associated with water absorption from the soil. When there is a deficiency of zinc, branches and needles do not grow as fast and they start to turn yellow. Cold winters are often the cause of these deficiencies and the spikes in Zinc in our research appear to have happened during above average temperatures during the winter months in those years. This could be the cause of these sudden spikes, however further research and data analysis in Asquith and Midale would need to be conducted to prove this hypothesis with an adequate level of certainty.

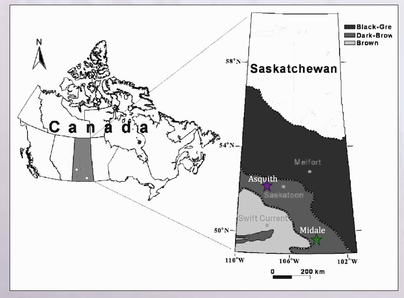


Figure 1

Figure 2

Figure 3

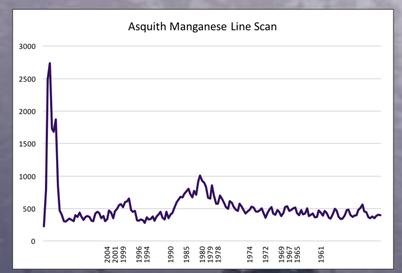


Figure 4

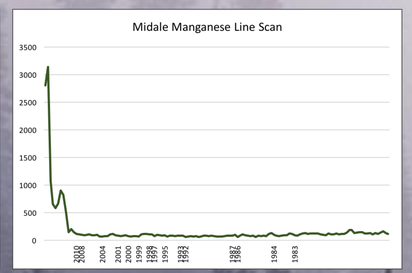


Figure 5

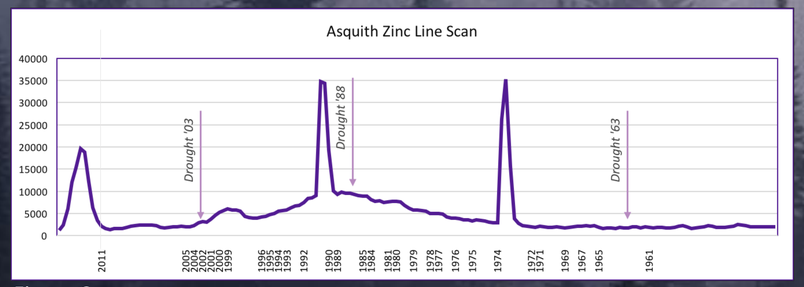


Figure 6

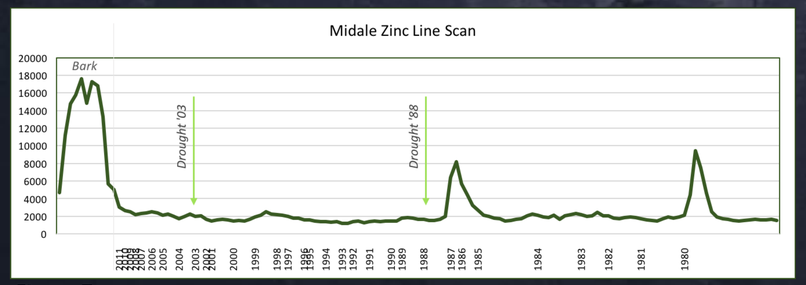


Figure 7

What is Inquiry Education?

Inquiry-based learning is a form of active learning that starts with a questions, problem or scenario—rather than simply presenting established facts or following a constructed path to knowledge. The learner determines his or her next steps towards understanding. The process is often assisted by a facilitator or teacher who challenges the learner to reach further, think critically, and continually reflect in order to reach his or her goal. During this process, the facilitators learn many new things alongside the students.

Inquiry as Learners

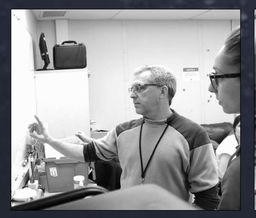
Trees are often undervalued in their ability to provide meaningful information about the environment in which we live. Not only are they essential for a healthy environment, but they also keep a record of the general quality of the climate and atmosphere of that environment. We, ourselves, underestimated the information a tree can provide, but quickly learned how important trees are to understanding our environment. Through inquiry, we learned a lot about trees, soil, and the environment, but also about science in general. Some of the greatest learning occurred before we even began our experiment, as this was when we were increasing our background knowledge and educating ourselves on the chemical makeup, the process of nutrient absorption, and the functions of a tree. Throughout the process, we learned that scientific experiments are not like recipes, but that they have obstacles that require you to change your thinking and improvise—but that's the fun part!

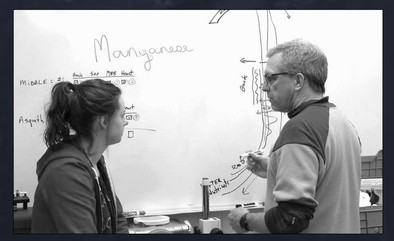
Inquiry as Teachers

Inquiry-based learning requires a teacher who is capable of scaffolding their students along the learning journey. Since the project was so open, we found it very difficult to get started on a topic and narrow down an area to study. Speaking with experts who can share their knowledge and answer questions quickly and accurately was a great asset to our inquiry process. Providing students with 'experts' to help them get going is definitely a valuable resource to have in an inquiry classroom. As teachers, we want high-order thinking from each of our students; inquiry allows for this through an in depth investigation process. By undergoing the inquiry process as students ourselves, our view of inquiry based learning in the classroom has changed substantially. We now look at it as a whole process rather than an end product. It involves activating prior knowledge, stimulating ideas, motivating students, and taking ownership for one's own learning. This type of learning fosters student curiosity, critical thinking, and an enhanced understanding of the topic under study.

Challenges & Benefits

Inquiry-based learning allows for students to take an active role in their learning. The process pushes students to reach further with their questions, think critically, and continually reflect on their learning. However, this type of learning is time consuming, as it requires time for students to explore and investigate their interests. Depending on the student's background knowledge on a given topic, the development of an adequate hypothesis to study could take a substantial amount of time in itself. However, if willing to devote classroom time to this type of learning, students will far surpass learning expectations set within the curriculum.





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