

Explore January: Salted, Not Sweet - How Road Salt Endangers the Sugar Maple

Road salt is quickly emerging as one of the most insidious and detrimental effects on the environment, and it is a tricky problem to address. The need for road salt to de-ice and create safer conditions for cars and pedestrians is undeniable, but so are the dangers posed when the salt finds its way into the soil and water. Road salt physically damages vegetation, such as the valuable sugar maple tree, and creates inhospitable conditions in both soil and water for all life. Though there are few concrete answers to this problem, research can offer us some solutions.



Why do we use road salt in the first place? The answer to that is simple chemistry: when salt is mixed with water, it lowers the temperature at which water will freeze, thus making it more likely that roads and sidewalks will stay wet but not frozen during the cold winter months. The salt that you use in your kitchen is chemically composed of sodium and chloride (NaCl) and is a purified version of road salt, which is typically used in the raw form that is mined directly from the earth. Along with whatever minerals are naturally found within the raw road salt, a compound called sodium ferrocyanide is also typically added to the de-icing agent to prevent caking during transport. This simple chemistry allows us the advantage of preventing road accidents and slippery sidewalk conditions, but the disadvantages are vital to recognize and address.

To begin scratching the surface of the threats posed by road salt, we should talk about the physical damage it can cause to nearby trees. Maples of all kinds have traditionally been used to line streets, and this means they are typically the first to be damaged by salt that is flung off the road by passing cars and spreading machinery. *Salt injury* can severely disrupt a sugar maple tree's growth or lead to its outright death when the tree's delicate new buds and twigs are physically damaged by the flying salt pieces. These new buds should become leaves that allow the tree to photosynthesize food during warmer months so without them, the tree has no chance of surviving.



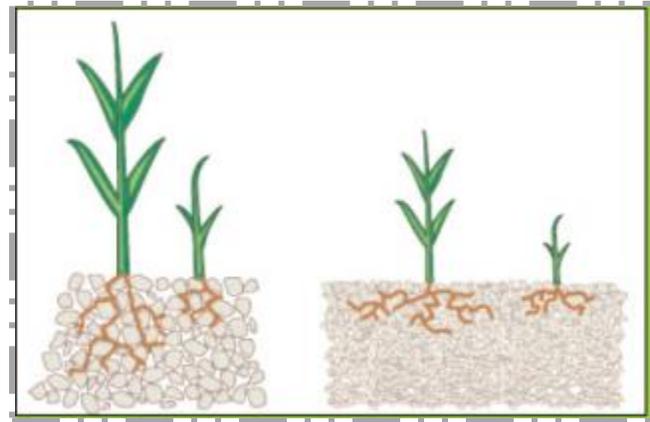
Salt injury on trees.

Beyond the damage inflicted on the tree's upper extremities, the salt continues to be a problem for the tree's growth beneath the soil: according to the USDA, "Sodium ions [from road salt] can effectively strip the soil of several macronutrient (calcium, magnesium, potassium, and ammonium) or micronutrient (copper, zinc, or manganese) cations that are required for plant growth. This



Road salt is toxic for all aquatic life, most of which forms the base of the global food web.

causes depletion in the soil, as well as changes the soil permeability causing the soil to become impervious which blocks water infiltration, reduces soil stability, and decreases the soil pH and overall fertility. This will reduce the growth conditions for plants.” (source: [USDA](#)) Along with infiltrating the soil and destroying its aggregation ([how soil binds together to allow for water filtration and aeration](#)) and nutrient levels, road salt causes toxicity issues in groundwater sources by raising the salinity of the water. Chloride in the salt is not able to be broken down by natural processes and is toxic to maple trees in excess quantities, so when the road salt mixes with groundwater and the chloride ions are taken up by the trees, they actually cause “burns” within the maple tree’s leaves. (source: [U of Maryland](#))



Instead of well aggregated soil (left) NaCl causes soil to compact and stress or kill sugar maple trees.

What is to be done?

While researchers are exploring more environmentally friendly replacements for road salt ([Read more about that here!](#)) our only concrete course of action is to be responsible and intentional with how much road salt and brine is used. All of these issues are caused by excessive application of salt; a conservative application allows for all the salt to mix with the snowmelt and stick to the surface of the road to create a non-slip brine. More than the necessary amount creates the opportunity for tires to fling undissolved salt off the road and carried away with the snowmelt into the soil, where groundwater contamination occurs. If we can all just start with being more mindful, we can do our part to ensure the protection of all our local life, including that of the iconic sugar maple tree!

Test Your Road Salt Knowledge!

Using the articles cited in this lesson, can you answer these questions about road salt and its impact on the sugar maple tree's environment? Each article and any specific pages that you may need are listed with corresponding questions.

🍁 [Potential Mobility of Road Salt](#)

1. Which ion that makes up road salt has a greater ability to affect a larger area?
2. The presence of salt in soil causes what dangerous process that threatens aquatic species?

🍁 [Aggregation](#)

3. True or False: Soil aggregates are living things.
4. True or False: Large pores in the soil are more important than small pores, which is why aggregates are important.

🍁 [Chlorine Toxicity](#)

5. Is chlorine presence within a plant unnatural?
6. What are some trees other than the sugar maple that are very sensitive to chloride toxicity?

1. Chloride ions 2. It causes toxic metals to release 3. False, they are pieces of soil held together by organic matter 4. False, they are both equally important and have different roles 5. No, it is essential in small doses 6. ash, boxelder, Siberian crabapple, dogwood, horse-chestnut, silver maple, sugar maple, pin oak, sweet gum, and yellow-wood

Road Salt and Maples Extensions

Activity: Salt and Ice

There are many simple salt and Ice experiments that can easily be done at home. For example, using information in this article partnered with prediction skills, even the youngest learners can make observations. This is a hands-on winter themed activity that can be used in an in-person or virtual venue.

Procedure:

1. Keeping time, illustrate each minute of what you see: 1 plain ice cube melting and an ice cube topped with salt melting. Which will melt more quickly, or will it be the same? How many minutes will each take?
2. Two celery stalks – place one in a cup of tap water and the other in salted water. Predict what will happen and discuss why you think so. Illustrate daily for a week.

Discussion:

Why did you get these results? Are they shared by your classmates or did your classmates get different results? Plot the results to see if you can develop a generalization based on data.

What variables might influence the results? Size of ice cubes, amount of salt, dimension of celery stalk, location in room, temperature in room, type of cup etc. Repeating the experiment(s), how would you run a “tighter” series of experiments? How do these experiments relate to environmental science?

[Click Here](#) to learn more about illustrations and scientific notebooks.

[Click Here](#) to learn more about the types of precipitation including freezing rain and sleet.

The topic of road salt can also be appropriate for environmental studies and various interdisciplinary content areas:

Chemistry – The composition of salt and on a molecular level, how it impacts other roadway materials. Are there replacements for road salt? If so, are they safer to use or do they hold additional risks?

Geography – If salts are used on the roads and highways, how does this practice influence watersheds? Are there predictable outcomes based on land formations and land use?

Civics and Governing Law – Consider such as this and develop your own queries: Your property sits at the end of cul-de-sac and at the bottom of a steep hill. All your neighbors freely and liberally throw salt on their driveways and sidewalks. Additionally, the town salts the road because of the steep incline. As the snow and ice melts, it runs down the hill onto your property which is edged by a series of sugar maple trees.

- In this circumstance, what might you start noticing about your property and about the trees?
- How might you handle the situation with the town and with your neighbors?
- What might you be able to do on your property to protect your trees?

For more ideas on how to incorporate this topic into your lessons, contact Kate Reilly, Manager of Education, Duke Farms. kreilly@dukefarms.org