



SK Curriculum MC5.2; MC5.3

Washing up a traditional way

Soap is a chemically-produced product with a unique property - it contains chemicals called saponins that make 'cages' around oil molecules, a process called 'emulsification'. In this way, they allow the fats to be removed from a surface or solution, acting as degreasers. If you want to see this in action, you don't have to go far - ask your teacher about trying the [magic milk activity!](#)

Today many soaps are made in factories, using industrial processes called 'saponification', but the chemical process of saponification is a natural one that is found in many plants - including buffaloberries, which produce natural saponins. Whipping squashed buffalo berries is an easy way to make 'soap' that is safe, natural, and delicious to eat in small quantities. Soaps are also made with vegetable oil, and rendered animal fat (tallow), and 'lye' a strongly basic solution made by soaking wood ashes in water. Traditional soaps have been made around the world for many thousands of years. In Saskatchewan the Metis people introduced tallow soaps, and traditionally used buffalo tallow. This new method was important to life on the plains, especially with the introduction of cotton fabrics to the Metis lifestyle.

In industry, soap-making is carefully controlled to produce a standardized product - the technicians use highly precise temperature probes, pH meters, and refined chemicals. What was the traditional way?

Metis women in Saskatchewan often made soap using hard grease and ashes. Hard grease is 'tallow' which is made by boiling fat and removing impurities in a large pot. Rendering tallow is a lengthy process and would have produced lots of wood ash with which to make lye. Lye is made by soaking ash in water until it contains sufficient potassium hydroxide, and is chemically 'basic.' How did they know when the lye solution was just right? U of S student Krista used oral history interview transcripts to find out, and then called contemporary Anishinabe and Metis buffalo tallow soap-maker, Kathleen Cloeclough (www.kakwa.ca), to find out more details. She learned of three methods: the colour of the solution changed when it was 'getting strong enough', an egg could be used to see if the solution was concentrated enough, and a feather could be dissolved if left in the solution overnight!

Making soap involves strong chemicals and exothermic (heat-producing) chemical reactions. In fact, if lye gets on your skin it will begin reacting with fatty acids in your skin - making you into soap! You probably won't be allowed to make soap from scratch in your classroom, but you can try out all three of these methods Metis women used to determine solution chemistry on their own.

RELATED MEDIA: Teacher's guide to soap-making, Krista Dmytryshyn; Metis Soap-Making Play Script

Activity part 1: 'Magic milk'

MATERIALS (per 3 students): tin pie plate or similar flat dish, toothpick, homogenized milk, food colouring, dishsoap

- Pour milk into pie plate
- Put four drops of foodcolouring into the dish, widely spaced so that they are not touching each other
- Try poking your toothpick into the centre of the milk - *does anything happen?*
- Dip your toothpick into the soap and try again - *what happens now?*
- *The colours are less dense than the milk, and so float on top of the milk. When you add dishsoap, it forms 'cages' around fat molecules in the milk, causing motion that is made evident by the swirling of colours 'riding on' the milk!*

Activity part 2: 'pH colour indicator' (30 min)

MATERIALS (per 3 students): black tea bags, beaker or bowl, vinegar, dishsoap, tap water, other

- Steep black tea in boiling water, allow to cool
- Now you have a dark brown solution – the colour arises from the presence of tannic acid, released from the tea leaves
- What happens when you add a drop of this solution to small dishes of vinegar, water, soapy water, other?

These activities were contributed by Krista Dmytryshyn, Sandy Bonny and the Science Ambassador Program (summer 2013)



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- Why does the colour change?
- The colour changes because the chemistry of the dye is affected by the pH of the surrounding solution. Colour is an interesting phenomenon - white light in the visible spectrum is split when it hits an object - some light is absorbed and some light is reflected up to our eyes. We see the colours that are reflected. For example, a red apple is reflecting red light, and absorbing blue and yellow light. When a pH indicating solution reacts with H⁺ or OH⁻ groups in an acid or basic solution it sometimes creates a shift in which colours are reflected and absorbed! The important point is that the colour of a solution tells us about how it will behave when mixed with other solids or solutions.
- Nature contains natural pH indicators: like some flowers (roses and Hydrangeas) change colour depending on the pH of the soil that they are growing in - you guessed it, these flower petals can be used just like the tea to make pH indicator solutions!
- Ash-water lye is another natural pH indicator - wood ash contains 'tannins' natural pigments found in wood and in leaves. Tannins and pH sensitive with tannin-protein bonds remaining stable until they breakdown at a pH <3.5 or >10. When the pH of the ashwater solution reached 10, a strongly basic lye, the colour of the solution would begin to change. This was one indicator that Metis women used to determine when the solution was ready for soap making. Ideally, they would look for a pH of 12 to 13 - as measured by a dissolving a feather or density test

Activity part 3: 'a dissolution test' (15 min, then overnight)

MATERIALS (per group): four mason jars, tongs, four fresh eggs, four solutions - measure the solution pH with your red cabbage indicator

- Four solutions:
 - neutral - tap water
 - weakly acidic - vinegar
 - strongly acidic - 10% HCl (available in most geology or hardware stores)
 - basic - dissolve NaOH in water (caution, exothermic reaction!)
- Carefully pour each solution into a mason jar
- Use tongs to gently lower an egg into each jar
- seal the jars and leave undisturbed for 24 hours
- Make your predictions!
- *Results - the neutral tap water should have no change - the egg will likely sink!; the weak acid will dissolve CaCO₃ in the eggshell but not the egg protein - you get a 'rubber egg' that is safe for the children to handle - see if it will bounce!; the strong acid will dissolve the Ca CO₃ and denature the egg protein, it will make a mess but is safe to handle once rinsed with water; the strongly basic solution? the shell dissolves (CaCO₃ (s) + 2 NaOH (aq) --> Ca(OH)₂ (s) + Na₂CO₃ (aq)) and excess NaOH solution will begin to react with protein in the egg, creating ammonia - this bottle will be a stink bomb! DO NOT HANDLE THE EGG)*

Activity part 4: 'a density test' (30 min)

MATERIALS (per 3 students): wide test tubes with stands, small meter sticks, sinkers, fishing line, indelible markers, fine salt, fresh eggs

- As potassium and hydroxide from wood ash mix with water in an ashwater solution, the density of the solution increases
- What is density? It is the mass per volume of a solution or material. We do not usually think of chemical solutions this way, but when we dissolve salt or sugar (or lye) into water, we are increasing its mass, and its density. At a certain density of KOH, the solution will also have a specific pH, so density can be used to determine when the solution is ready to make soap
- The current industrial method of soap-making uses molar calculations and saponification numbers to determine the exact amount required to produce a specific concentration for the reaction as well as pH measurements and density calculations

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- Here is a test used by some settlers to get the concentration of an ashwater solution just right - it is a form of 'calibration', give it a try!
 - Dissolve salt in a 1L beaker of water until no more salt will dissolve (it will only settle to the bottom). Tie a small weight to one end of a short ruler so that it can float in the water - tie a fishing line to the other end so that you can keep it upright without affecting the mass of the ruler too much. Note where the top of the water meets the ruler. You now have a density indicator that can be used to 'calibrate' the ashwater lye solution. You would move the ruler into the lye and aim to get it floating at exactly the same mark - if it is above the water, you would slowly add fresh water to the lye until it was right. If it was below the water, you would heat the lye to boil off some of the water and increase its density to the 'correct distillation for making of soap.'
- The homesteader and Metis method of 'floating an egg' which was used in Saskatchewan might seem less exact, because there is no ruler and no numbers involved. In fact, it is quite precise. Fresh eggs have a very repeatable density, so floating an egg to 'just the right depth', a knowledge passed on by experience between knowledgeable women through an oral and lived tradition, was a very good way to get the density right. They would put an egg in the water so that it floated with just a small circle 'the size of an iris' or 'a quarter' or another indicator that was familiar among teacher and learner
- Mix up some beakers or wide test tubes of 'mystery solutions' and see how the 'egg test' and 'density meter' compare!

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