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| Topic | Objectives for lesson – each start with “how do we use it at the ranch” | Practical or demo |
| Photosynthesis | * The chemical formula for photosynthesis * An understanding of the water cycle and its relevance in the ranch * Food cultivation at the ranch vs import (sustainability issue) | Tour of the property Chemistry of Sustainability – Syllabus  * Walking in the orchards – discussing how trees produce that material * Looking at the structures - what are they made of; bamboo, timber, earth * Zone 1 – food that feeds us, recapping that the plants create this material by photosynthesis * Looking at water storage systems, grey water and erosion problems. |
| Combustion | * Fuel triangle * What is complete/incomplete combustion * The reaction for the combustion these three fuels. * Aerobic and anerobic reactions to produce methane\* | Looking at the three ways we generate fuel/heat   * Using the rocket stove to make candy – relating this to the trees we use and the process of combustion, discussing the sugar in the candy and the local sugar cane. (referencing back to photosynthsis) * The use of propane as a backup source – the efficiencies of this comparatively to methane. * Biodigester – discuss the anerobic and aerobic process that yield methane\* |
| Lime cycle | * What is the lime cycle * What is thermal decomposition * How to test for the presence of Carbon dioxide | How we use lime at the ranch   * Corn nixtamilisation \*(using combustion in this process) * Applying lime to the orchard as a soil amendment (referencing photosynthesis) * Comparing plaster samples * Group practical demoing aspects of the lime cycle –e.g.using limewater to prove presence of carbon dioxide. * And also thermal decomposition of sodium bicarbonate (as it is possible in the oven) and showing the difference in texture and pH\* |
| Acidity | * Chemical formula of vinegar * Reaction for the formation of alcohol and then to vinegar * The conditions necessary to cultivate the acetobacteria * Basic neutralisation reactions | How we use vinegar at the ranch   * Making a pineapple vinegar * Making a cleaning solution * Tasting some different vinegars * Reacting vinegar with lime in a basic neutralisation reaction. (references lime cycle) |
| pH and titrations | * Recap of acids and alkali and neutralisation * What is pH and how to calculate its value   Calculating the percentage of CaCO3 in egg shells | How we exploit pH at the ranch   * Making red cabbage indicator – and using it to test some substances at the ranch (references vinegar and the lime cycle components) * Doing a (crude) titration or designing an experiment to suggest the percentage of CaCO3 in egg shells. * Critique Plaster fiber experiment or design their own * Why we use is as a soil amendment (referencing lime cycle) |
| Soap | * Making soap and having an introduction to the saponification process * Evaluating the pros and cons of the different fats and how you might make this more sustainable. * Discussing why we don’t use ‘pot ash’ to produce our soap. | How we make soap at the ranch and how you could do it   * Making soap * (References fatty acids and lye from the pH topic) * Looking at tadalact plaster |
| Fermentation | * Process for brewing alcohol * Distillation process * Fermentation of foods using lactic acid | -Making kimchi  -Making natural sodas  -Distilling an alcohol  - Making a hydrosol |

\*objectives pertaining to IB students.

Summary tasks

* Making their own **mind map** to show all the different ways in which carbon is affecting their lives and life at the ranch.   
  *Points for reactions and formula.*
* Evaluating its all these uses of carbon and presenting its context and relevance in the debate about climate change. E**ssay or presentation**
* Is the ranch acting sustainably or not? **Moderated discussion/debate**
* **Final presentations** with a panel of judges – class teacher, myself, a core team member from the ranch.