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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.
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| 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\*
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| 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\*
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| 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)
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| 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)
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| 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
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| 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.