

## Analytical techniques to study the Earth's past

The Organic Geochemistry Unit (OGU) is an international research group that uses analytical techniques such as gas chromatography mass spectrometry (GC-MS) to investigate Earth systems at the molecular level. The group undertakes research in a diverse range of fields including: archaeology, biogeochemistry, and palaeoclimatology. Examples of things we do include reconstructing the Earth's paleoclimate by studying



blogs.getty.edu

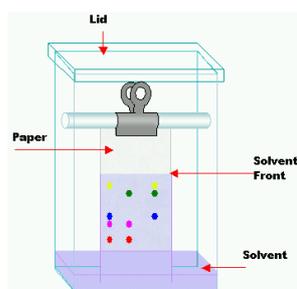
Cochineal dye is a red colourant that can be identified in paintings by GC-MS analysis. However, this is better known as a food colourant – you might have encountered in ketchup or jelly beans. But do you know what cochineal is? An insect that lives on cacti!



Quora.com

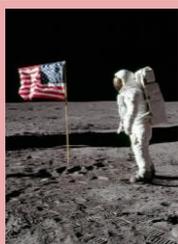
biomarkers fossilised in sediments, and answering questions about our ancestors' diet by analysing lipid residues in pottery, or about criminal activity by investigating the geochemistry of soils.

Chromatography is an analytical technique which is able to separate single compounds from a complex mixture, whereas mass spectrometry is able to fragment a molecule and record the different 'pieces'. Each molecule will fragment in a specific way, so that by looking at the recorded pattern, the molecule may be identified.

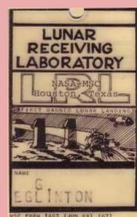


Wikipedia (Theresa Knott)

Gas or liquid chromatography are analytical techniques used in our labs, but the original type of chromatography is paper chromatography, which you will be undertaking today. This technique is able to separate compounds, such as different colourants in ink, or pigments in leaves. It works thanks to a mobile phase, the solvent, which travels along a stationary phase, the paper, by capillary action. As the mobile phase travels the different compounds investigated are separated depending on how much affinity they have for the mobile and the stationary phase. So, if a compound 'likes' the stationary phase a lot, it will not travel up the paper very much, and if a compound prefers the mobile phase it will travel along the paper more.



hq.nasa.gov



bristol.ac.uk

Prof. Geoff Eglinton, founder of the OGU, was amongst one of the first people to study moon rocks; collected during the first landing of man on the moon by Neil Armstrong and Buzz Aldrin in 1969, during their Apollo 11 mission. Eglinton and his team were asked to study the organic composition of the rocks and to determine whether any form of life was present. They concluded that it wasn't, and they demonstrated the presence of methane on the moon, produced by chemical reactions driven by the solar wind.

## Leaf chromatography

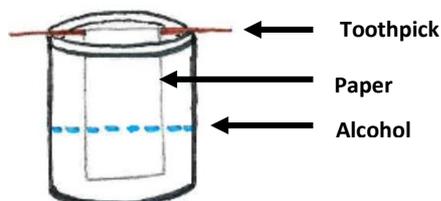
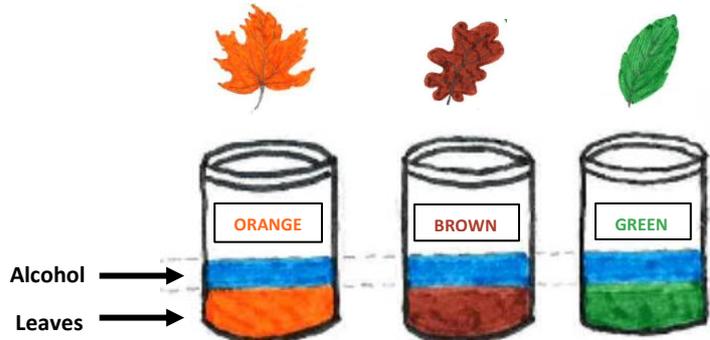
Plants get their colour from three different types of compounds: Chlorophyll (green), carotenoids (yellow/orange), anthocyanins (red). The latter start being produced in the fall, before leaves fall off trees. Carotenoids and chlorophyll, instead, are produced all year round. Paper chromatography can separate these different pigments in leaves.



The experiment will require:

- Different coloured leaves (green, orange, yellow, red), a few of each colour
- Isopropyl alcohol
- Mortar and pestle (or a wooden spoon and a glass)
- Filter papers (or coffee filters)
- Toothpicks (or pencils)
- Glue (optional)

3. Separate leaves of each colour, tear them to pieces, and crush them with a mortar and pestle (or the back of a wooden spoon into a glass).
4. Place the crushed leaves into different labelled glasses (one for green, one for yellow, etc...).
2. Pour some isopropyl alcohol into each glass, enough to cover the leaves, mix well and leave for a couple of hours (After a few hours you can either filter out the leaves to better see the colour of the solution, or leave them in there).



1. Cut your coffee filter paper into rectangular strips. Wrap and glue one of the short ends onto a toothpick or similar (the toothpick needs to be able to rest on the rim of the glass), so that you can place the filter paper into the solution without it touching the side of the glass. You don't need the glue if you can rest the filter paper on the toothpick.

5. Leave for at least one hour, after which you will observe the separation of pigments on the filter paper.

For more info, or a visual guide of the experiment, see <https://www.youtube.com/watch?v=qH-AJDqsSII>