Creative Chromatography

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Age group

7 – 9 years old

Curriculum focus

Science

Time needed

45 – 60 mins

About the activity

Students:

- explore mixtures, separations and changes
- are introduced to chromatography
- test ink samples (which represent oils) to identify the cause of the broken engine
- consider fair testing
- explore some other uses for chromatography

What you will need

- Student workbook (one per student)
- Presentation slideshow
- Data projector or overhead projector and screen
- Prizes (pencils, erasers, sharpeners etc.) for activities that you decide to make into a competition
- Color pens as below

For each group of 2–4 students

- Student workbook (one per student)
- Presentation slideshow
- Data projector or overhead projector and screen
- Prizes (pencils, rubbers, sharpeners etc.) for activities that you decide to make into a competition
- Color pens as below

To create the 'oil' samples

- USE COLOR pens in blue, light green, purple and yellow

You can use a single set of pens or provide a set for each group. Ideally, wrap and tape some white paper around each pen and label as follows:

- Yellow pen – 'Sealed BP container'
- Purple pen – 'Other container from garage'
- Black pen – 'Opened BP container from garage'
- Light green pen – 'Car engine sample'

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Timings and structure

Activity	Time (mins)
Introduction and Q&A	5
Activity 1: Mixing and separating	10
Activity 2: What is chromatography?	10
Activity 3: The broken engine!	5
Activity 4: Preparing our test	5
Activity 5: Identify the oil	10
Activity 6: More uses for chromatography*	5
Round up	

*optional activities

Prior Knowledge and Preparation

It's helpful if students are already familiar with ideas of mixtures, separating, and reversible/ non-reversible changes. The class should also be able to consider some simple ways to make their ink tests fair.

Preparing the 'oil' samples

It's fun for students if they can 'take' their own samples. You could have four plastic containers ready, each containing a number of each color of pen, and labeled as above.

You could add drama by taking on the role of a 'BP investigator' when you brief the teams. The teacher and teaching assistant or other BP volunteers could be the lady car owner and her husband.

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Delivering the activities

Introduction and Q&A (10 mins)

Introduce yourself, the topic of chromatography and the challenge: to use their science skills to solve a problem.

1. Explain who you are and what you do for BP.
2. Explain that students are going to learn about a special way to separate mixtures. They must plan a fair science test to examine some oil samples and identify why a car engine has broken.
3. Use slide 2 to review what the group will do.

Activity 1: Mixing and separating (10 mins)

Help students recall what they know about mixtures, solutions, reversible and irreversible changes, and separating mixtures.

1. Ask students for the name for when we combine two or more substances together (a mixture, or solution of a solid is dissolved in a liquid). See how many mixtures/ solutions they can name (you may, with more advanced students, need to make the distinction between a compound (where substances are chemically combined) and a mixture.
2. Show slide 3 and discuss some other mixtures that you or students can think of.
3. Can we un-mix things that we've mixed together? Ask the class and then show slide 4.
4. Discuss ways to un-mix (separate) mixtures, such as filtering, evaporation or manual separation. Use the last example to highlight that to separate a mixture, the substances must not have reacted together in some way.
5. Introduce a new sort of mixture: mixing colors. Discuss how students can do this by mixing paint, but don't say too much about specific color mixtures or combinations as you may give students the information they need to solve the problem.
6. Ask students: once the paint is mixed, can they separate their new color back into the original colors?

Activity 2: What is chromatography? (5 mins)

Explore how chromatography is a way to separate mixtures into their components, especially inks and dyes.

1. Establish that paints or inks are mixtures or solutions in water, but don't give or ask for any specific examples.
2. Use slides 5-7 to give a brief overview of how paper chromatography works:
   - It works on the basis that each component of the mixture is soluble to a slightly different extent than the others.
   - If we pass a dissolved mixture though some solid substances like paper, each component (i.e. each ink color) will travel through the substance at a different speed – some faster, some slower.

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- Chromatography is a bit like a running race, where each person represents a substance: they all start together, but each travels at a different speed so, after a while, the 'group' is spread out. So here, the blue dye was the 'fastest runner' while the yellow dye was the 'slowest'.

3. Explain that chromatography lets us find out what's in a dissolved mixture by 'spreading out' the different substances so we can see each one separately.

Activity 3: The broken engine! (5 mins)

Teams are introduced to their challenge.

1. Separate students into groups of 2 – 4 and explain that they work in a special testing laboratory at BP.

2. Show slides 8-9 and introduce the scenario: a lady's car engine has broken since she changed the engine oil using what she says was BP engine oil. She thinks BP has caused this problem and wants BP to pay for a new car! It's students' jobs to find out what's really happened.

3. The team's challenge is to match an oil sample from the car engine to samples taken from a BP oil container in the garage, another container with some 'mystery' oil in it and an unopened BP oil sample. Can they spot the problem substance – and where it came from?

Activity 4: Preparing our test (10 mins)

Teams work together to plan a fair test for the 'oil' samples.

1. Show slide 10. Explain that students are going to use filter paper to separate their samples. Read the lab notes together.

2. You may want to show students how to add 'oil' samples to their filter paper and fold it to fit into the cup or glass (see the instructions in the lab notes).

3. Explain that students need to make their test fair. If they don't, the lady's lawyer could argue that BP hasn't been honest when analyzing the samples, and BP might need to pay for a new car even if the problem wasn't caused by BP oil.

4. Teams work together and write down ideas for fair testing. For example:

   - Same amount of water in the bottom of the cup or glass
   - Same amount of each 'oil' sample (i.e. equal size marks on the filter paper)
   - Same amount of time for each sample

Activity 5: Identify the oil (10 mins)

Teams test each 'oil' sample following their lab instructions

1. Start teams off testing their 'oil' samples. Brief them to make sure they place their samples in the right place on the filter paper and then fold it so each sample is equally above the water level.

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2. Circulate to make sure each team is:
   - Following their lab notes carefully
   - Making equal sized sample spots
   - Keeping their filter paper level and with the samples above the water level
   - Noting the colors into which each sample separates
3. Students should also label their lab notes diagram while they work.
4. Get teams to fill in their lab report and identify the similarities between each oil sample. Remind them that they are looking for a color that's not in the unopened BP oil sample, and where it might have come from.
5. Help teams identify that something that's in the mystery oil is also in the BP container in the garage – and in the car engine. But it's clear that the BP oil itself hasn't caused the problem (it doesn't contain any light blue) – but what is this mystery oil?

Answers

	Sample from car engine	Sample from sealed BP engine oil	Sample from opened BP container in garage	Sample from other container in garage
Color	Green	Yellow	Black	Purple
Colors observed	Yellow Light blue	Yellow	Light blue Yellow (look carefully below the blue) Reds Purples	Light blue Purples
Contains	BP oil (leftover from its previous 'good' oil) Mystery substance (from the oil change that's caused the problem)	BP oil	BP oil (leftover from when the container was new and full) Mystery substance Other substances	Mystery substance Other substances

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The engine should only contain yellow but also contains light blue. This is the 'culprit' substance that's also in the opened BP container and the other container.

6. Make the following announcement: "I've just had an email from my colleague and they've identified the 'mystery oil'. It's used cooking oil, like you might find in a deep fat fryer! The other substances appear to be particles of potato. What on earth's been going on? Can you guess?"

7. At this point, if a teacher, teaching assistant or BP volunteers is 'playing' the role of the husband, they could come forward and 'confess'.) Explain that the husband is supposed to be on a diet but has been making french fries in the garage and hiding the used cooking oil in an old oil container. When the container became full he tipped the last lot of cooking oil into the open BP oil container! Explain that this is based on a real-life case where BP identified that used cooking oil was the cause of some engine problems.

8. Optionally, review how the ability to mix and separate colors has helped students solve the mystery. Show slide 11 and refer to the background notes to help you make the distinction between when ink or dye colors are mixed, and when colors of light are mixed.

Activity 6: More uses of chromatography (5 mins) (Optional)

Students learn of some other applications of chromatography.

1. If you have time, briefly review some of the other uses for chromatography, using slide 12. There is no need to go into the practicalities (e.g. gas chromatography), but for each example, discuss why this might be important, e.g.
   - food safety
   - safety at airports, and smuggling
   - environmental protection near industry (you could link to BP site management)
   - testing to ensure the correct levels of additives in BP oils and fuels (this uses a form of 'thin layer chromatography' that's a more high-tech version of what students did in their activity)
   - crime scene identification.

Round up (5 mins)

1. Thank students again for taking part and congratulate them on their lab skills and detective work

2. Ask general questions to review what students have learned about separating mixtures and how colors behave.

3. Conclude by saying that you hope they have enjoyed using their lab skills to solve a problem and answer a question. Perhaps they might use these skills in BP one day in the future!