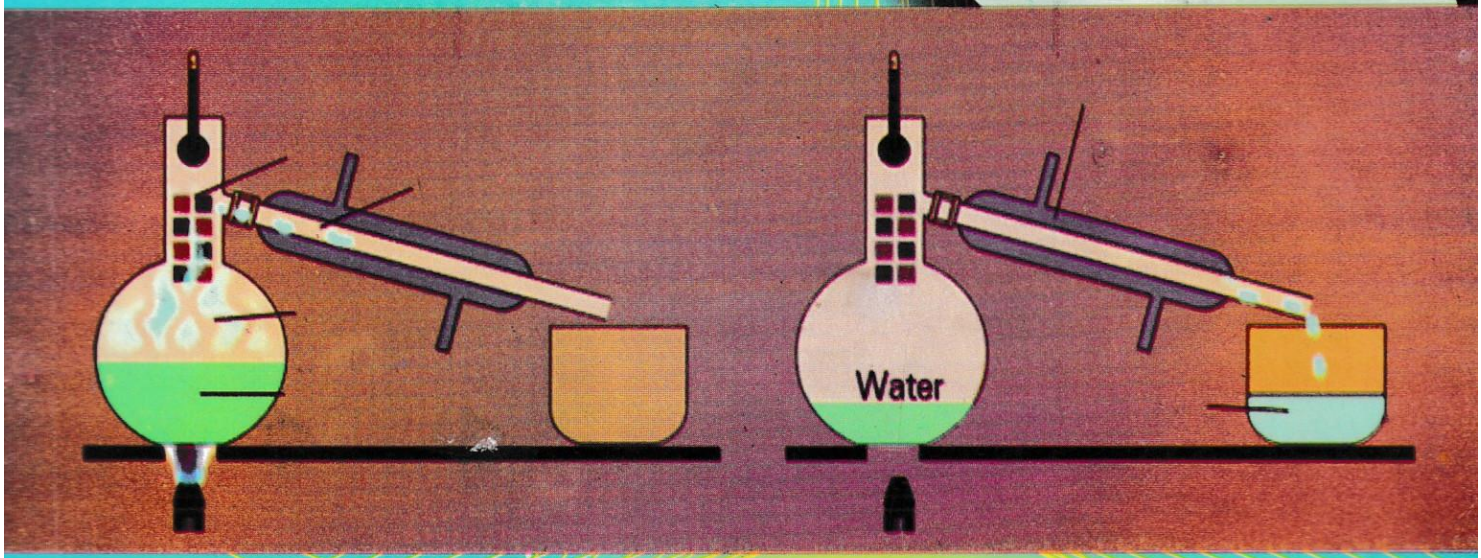
SCIENCE TEACHERS ASSOCIATION OF NIGERIA
CHEMISTRY PANEL
SERIES 12

NATURE OF MATTER & SEPARATION TECHNIQUES



A HANDBOOK FOR
CHEMISTRY TEACHERS

PAPER 12

SIMPLIFYING TEACHING OF PAPER CHROMATOGRAPHY USING ENGAGEMENT APPROACH

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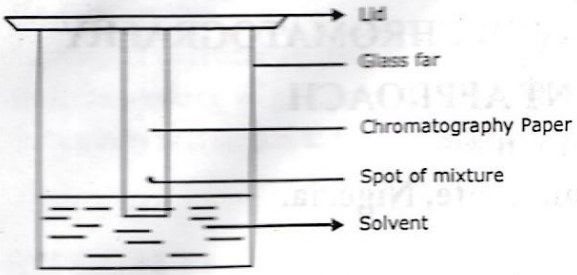
Introduction

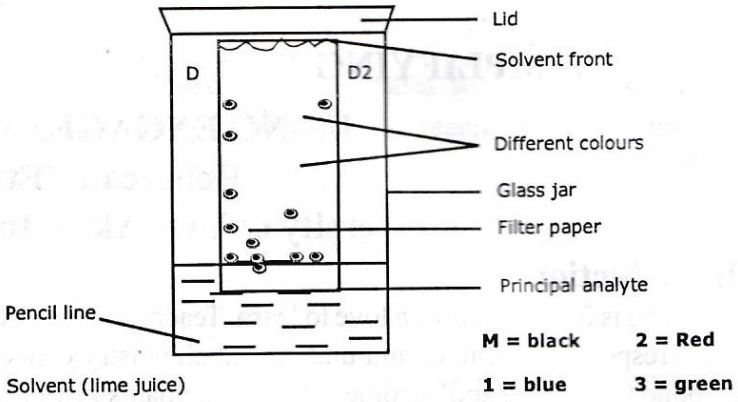
Learning is fun and children love to learn. Teachers therefore must engage learners in different ways to make them respond adequately and understand chemistry concepts effectively. Doing this, will make students respond to learning and become active participants in problem solving. This way, meaning and relevance is given to knowledge assimilation.

Chromatography occurs in everyday life activities involving actions like using toothpaste to brush the teeth. They include toothpastes that come in varieties like colgate, pepsodent, darbur; close-up, aqua-fresh and macleans. Other actions are drinking fruit juices, paints of different colours and textures, writing with different colours of biro opens. Students and teachers write with different colours of biro pens on a daily basis on a paper/book. They touch, feel and use biro pens every time. They may not have considered what biro pens are and why writing is possible with biro pens. Chromatography, on the other hand, is a topic taught in secondary school and offered by students in internal and external examinations. Chemistry students therefore need to be familiar with the materials, characteristics and behaviour of chromatography phenomena. Students are exposed to questions involving chromatography in the yearly, terminal SS3 examinations, but they perform very poorly. This may be due to lack of understanding of chromatography processes and this leads to inability to answer correctly questions that relate to chromatography. This also reduces students' interest in the concept. This calls for a new approach to teaching chromatography to bring relevance and facilitate students' knowledge using day to day activities.

Teaching methods should be stepped up to meet 21st century knowledge sharing. Employing effective teaching methods helps a teacher to equip students to become active participants in solving daily occurring problems with ease. An effective teaching approach that is easy to use is the engagement approach. This is a resource teaching approach that brings chemistry alive in the minds of students. It inspires curiosity in the mind of learners. Lloyd (2015) defined engagement strategy as an approach that promote conceptual understanding through interactive engagement of students in heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors. Engagement approach enable students to work autonomously, enjoy learning relationships with others, and feel they are competent to achieve their own objectives. The teacher, whose teaching is central to the engagement, help students to be well prepared, focused, be sensitive to their needs and ensures their commitment to hard work; gets more out of the session and are more willing to express their opinion. They must believe they can learn, including that they can overcome their failures. The teacher also helps to create educational experiences for students that are challenging and enriching and this extend their academic abilities. Easy learning activities and assignments are not as effective as engaging students at activities and assignments that challenge them. When students are reflecting, questioning, conjecturing, evaluating and making connections between ideas, they are engaged (Zepke and Leach, 2010). Teachers need to create rich educational experiences that challenge students' ideas and stretch them as far as they can go for engagement to be effective.

Chromatography is a method of separation that occurs every day in homes, offices, business centres and schools. It is a concept that needs to be taught effectively to make learners productively engaged to carry out practical activities to gain knowledge for its usefulness. It cannot be taught in abstraction. Its usefulness and application for separating amino acids, finger print detection, histamines,





dyes such as used in biro pens cannot be underestimated. This work looks at the simplest chromatographic technique which is paper chromatography. There are lots of materials that can engage students' understanding of paper chromatography. This involves the mixture to be separated distributed between two phases – a stationary phase and a mobile phase that consist of samples to be separated and the solvent that moves samples through the column, taking advantage of different rates of movement in a solvent over an adsorbent medium. It is a technique that uses a small dot containing the sample mixtures to be separated, on line of sample solution onto a strip of chromatographic paper (litmus paper which is made of cellulose a polar substance). The paper is placed in a glass container with a shallow layer of solvent and sealed. Solvent could be lime, methanol, alcohol, water. As the solvent rises through the paper, it meets the sample mixture which starts to travel up the paper with the solvent.

Diagrammatical Representation of Paper Chromatography (Ascending)

Paper chromatography can be taught with the simple sample (format) using engagement approach as follow:

Lesson:	**Paper Chromatography**
Teaching Strategy:	**Engagement Approach**
Class:	**SS2**
Time:	**90 Minutes**

Behavioural Objectives

i. List the materials for paper chromatography
ii. Mention the chemical principles used in paper chromatography
iii. Describe the procedure involved in paper chromatography
iv. Determine colours and peaks in a chromatographic column
v. Determine the retention factor (Rf) of each analyte in the experiment.

Set Induction: Students are familiar with the biro pens they have used throughout their writing lives. They used an illustrated diagrammatic chart to carry out the experiments (in clusters) of five in a class of 50 chemistry students.

Activity 1

Students' Activity
Provide materials such as fitter paper, four felt tip pens (black, blue, red and green), glass jar, pencil, metre rule solvent (lime, ethanol and distilled water) gloss tape, knife for cutting lime, glass plate.

Activity 2
Use felt-tip pens/dots of black, blue, red and green as colours and peaks to be determined in chromatographic column. Dyes and colours from Hibiscus flowers may be substituted too.

Cut lime with knife and squeeze juice into container (glass jar) Glass jar tightly closed to enhance capillary action. They determine actions taking place on analytes.

Activity 3
Attach already shaped filter paper vertically on the surface of glass plate
- Measure solvent and put into well cleaned glass container 5ml – 10ml by
- Draw faint straight line across breadth of filter paper using pencil and metre rule. They use letters and numerals on the thick dots to indicate the analytes.
- Dotted marks immersed in solvents.

Activity 4
They carry out the experiment themselves by dotting different pen dyes (black, blue, red and green) on the absorbent medium (filter paper) a little above the pencil mark.
- Make careful observations to see rise of analytes due to capillary action up the filter paper with dotted analytes.
- Remove filter paper gently from glass container. Detach gently and dry. Measure peak, solvent and distant of individual colours using metre rule.

They determine the retention factor (R_f) of each analyte using the $R_f = D_1/D_2$

Teacher's Activity
Observes students tasks after providing enriching practical environment. Make sure filter paper (stationary phase) (porous) is used not ordinary paper.

Observe if learners know that dots are analytes (solutes

Finds out learners awareness of capillary action taking place in the system. Facilitate if they lose touch with tasks assigned.

Note that filter papers are vertically attached and solvent measured to appropriate ml/cm^3

Faint lines drawn accurately from below the filter paper immersed in solvent
See whether students are following through the experiment accurately.
Note if careful observation of events (processes) is reported by the students.
Anything unusual reported on the principal analyte (M), fair, good, better reasoning attempted.
Finds out if they worked according to expectation to determine Rf.

Engagement Approach
Students figure out actions taking place in each step-by-step process by reflecting, questioning, reasoning and trying to make connections between ideas for each step taken. They discuss their expectations of what and how the experiment could be.

Students are actively engaged as they learn new ideas, skills and knowledge.

They conjecture through questioning the usefulness of the experiment, asking questions such as:

(i) What are biros made of?
Why do we need ink in a biro to write?

(I) Why is ink needful in a biro?

(ii) Why is ink filled in biro pens?

(iii) Why are there different colours of ink in a biro pen

(i) How can the quality/quantity of ink be determined in each coloured biro pen?

(ii) Can any other dye (ink) type be substituted in a biro pen?

(i) What is the ink of a biro pen made of?

(ii) Are they observing differences along dotted spots movement?

(iii) Can they deduce what actions are taking place?

(iv) Can they determine colours and peaks in chromatographic column?

(v) Can they observe movement of solutes (analytes) on column?

(vi) What can they deduce from experiment?

What do they observe from the R_f at the end of the experiment? Did they find the

Students observed that the blue colour travelled faster than the red, brown, purple and lastly green. They were excited at using their own biro pens to understand a concept they have been trying for long to understand. Students with this experience observed that the principal Analyte (M) had the following colours blue, brown, red, purple and green were incorporated in it. Students can use the experience obtained from this experiment to carry out activities on toothpastes, fruit juice, soft drinks, detergents and cosmetics to determine various levels of substances in them.

Evaluation

1. List the materials used as analyte in the experiment.
2. Determine the colours and peaks in chromatographic column.
3. Determine the Retention factor (R_f) of each analyte used in the experiment.

Conclusion

Chromatography is a separation technique of interest in various fields of chemistry, industry and medicine and should be taught practically and not in abstraction using simple teaching approaches like engagement approach. It should involve students' active participation using heads-on, minds-on and hands-on activities to stimulate students' interest and enhance their performance towards a lifelong career path.

References

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Zepke, N. and leach, L. (2010). Improving student engagement: Ten proposals for action. *Active learning in Higher Education,* 11(3):167-177.