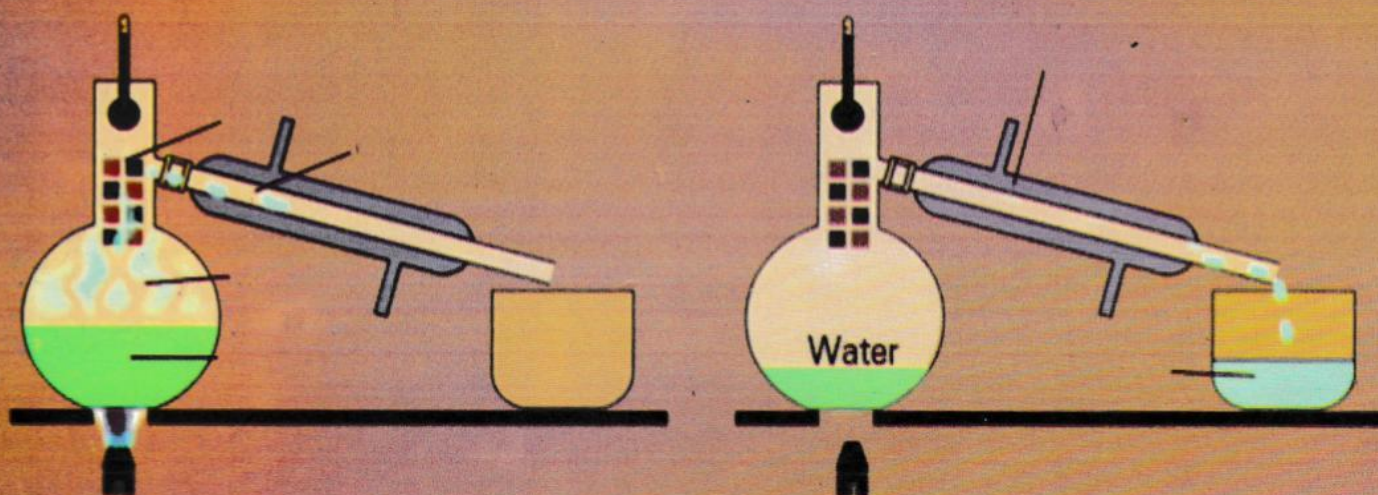


**SCIENCE TEACHERS ASSOCIATION OF NIGERIA**  
**CHEMISTRY PANEL**  
**SERIES 12**

**NATURE  
OF MATTER**

**&**

**SEPARATION  
TECHNIQUES**



**A HANDBOOK FOR  
CHEMISTRY TEACHERS**

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**NATURE OF MATTER & SEPARATION TECHNIQUES**

**A HANDBOOK FOR**  
**CHEMISTRY TEACHERS**

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**PAPER 10**  
**EXPLORATORY-DISCOVERY LEARNING:**  
**AN INNOVATIVE STRATEGY FOR TEACHING PRECIPITATION**  
**AS SEPARATING TECHNIQUE IN CHEMISTRY.**

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### **Introduction**

The chemistry curriculum is packaged with specific contents to imbue students with the spirit of inquiry and knowledge generation in the subject and its various applications. Chemistry as a relevant and experimental science subject demands a proactive teaching method with effective students' involvement in hands-on-minds-on experiences to generate knowledge, develop scientific skills, attitude and social values that would equip them to solve problems and contribute to national development. Various instructional delivery strategies and models have been used by chemistry educators and proved efficacious in enhancing conceptual understanding and acquisition of skills. Among such strategies are, constructivist model, (Gbolagado, 2009), project-based strategy (Olatoye and Aderogba, 2011), generative strategy (Ogunleye and Babajide, 2011a) and the problem solving strategy, (Ukoh, 2013). Ajeyalemi (2011) emphasized those modern teaching strategies for flexible deliveries should be adopted in order to reform the traditional talk and chalk and attract students to study chemistry.

This assertion is in line with the National Policy on Education (2013) which stated that the study of sciences and technologies shall be participatory, exploratory, experimental and student-centered for students to acquire practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. Hence, contemporary and innovative instructional strategies such as cooperative learning, experiential, problem-solving, guided-inquiry, generative and meta-cognitive approach emphasize active students learning and group interaction. Njoku (2007), Adesoji and Ibraheem (2009) and Udo and Udofia (2015) recommended different student-centered instructional strategies such as student teams-achievement divisions strategy and exploratory-discovery to reduce the abstract nature of chemistry concepts, motivate, arouse and sustain students' interest in chemistry.

Exploratory-discovery learning is a student-centered strategy which involves learning through reflection on direct experience in scientific activities. It emphasizes personal involvement and self – initiated evaluation by the student thereby making learning a personal activity. Chemistry teachers therefore must be well experienced on how to effectively apply instructional strategies that establish relationship between activities and knowledge content of the chemistry concepts for students to achieve meaningful understanding and learning.

### **Matter and Separation Techniques**

Matter is anything that has mass and occupies space. This implies that all living and non living things are matter. Matter is made up of chemical substances characterized by physical and chemical properties. The physical properties of matter form the basis of classifying matter into states: solid, liquid and gas while the chemical property classifies matter into elements, compounds and mixtures. The physical properties of matter include colour, melting point, boiling point, density, odour, taste and solubility, solid, liquid or gas.

There are various separating techniques that can be used to purify mixtures. These can broadly be grouped into separation of solid from solids such as sorting, winnowing, magnetization, sieving, sublimation, floatation. Solids are separated from liquid through evaporation, crystallization, filtration, precipitation and

centrifuging. Separation of solvent from solution, are through distillation while separating funnel and chromatography are for separating complex mixtures. These methods depend largely on the physical properties of the constituents elements of the mixtures.

### **Precipitation as a Method of Separating Matter**

Precipitation is one of the separating techniques applied to separate ions in solution in which one of the ions does not dissolve in a given reagent. Thus, the principle of differences in solubility of the constituents of substances is adopted to separate mixtures. One of the student-centered strategies that can be used to teach precipitation meaningfully is Exploratory Discovery Strategy (EDS) is a step by step strategy which involves students learning through active experimentation, interaction and reflection on the experiences for deep understanding of the concept. In teaching precipitation using EDS, the following steps can be adopted:

#### **Step I: Experience:**

- I. Teacher groups students into small heterogeneous groups of five students per group and provides materials for hand- on activities for each group
- II. Teacher writes the topic for the lesson on the board.
- III. Students are guided to engage in active experimentation, observe and record their results.

#### **Step II: Sharing:**

- I. Students communicate and discuss based on experiences from the experiment.
- II. Students share their experiences within their groups.

#### **Step III: Process:**

- I. Teacher guides students to organize experiences gained into meaningful information.
- II. Teacher facilitates interaction as students modify the experiences and reform new knowledge based on the topic.
- III. Teacher explicitly explains the lesson.

#### **Phase IV: Application.**

- I. Students solve problems and report their answers individually.
- II. Teacher writes the summary of the lesson on the board.

### **Application of the Exploratory- Discovery Strategy Steps to the Teaching and Learning of Precipitation as Separating Technique in Chemistry.**

**Subject:** Chemistry.

**Lesson:** Standard separation techniques for mixtures.

**Topic:** Precipitation as a method for separating mixtures.

**Class:** SS 1

**Gender:** Male and Female

**Time:** 40 minutes.

**Objectives of the lesson:** By the end of the lesson students should be able:

1. Define matter and classify matter based on chemical and physical properties.
2. Manipulate different apparatus and separate a mixture of sodium chloride and iron (II) sulphate.
3. State the principle applied in choosing precipitation as separation technique.

**Instructional materials:** water ( $H_2O$ ), sodium chloride ( $NaCl$ ), iron (II) sulphate ( $FeSO_4$ ), test tubes / beaker, filter paper, ethanol, measuring cylinder and spatula.

## Instructional and Learning Activity

### Step I: Experience:

- I. Teacher groups students into small heterogeneous groups of five students per group and provides materials for hand-on activities for each group through guided approach.
    - i. Put two spatulas of NaCl in a beaker provided.
    - ii. Add two spatulas of iron (II) sulphate ( $\text{FeSO}_4$ ) to the beaker containing NaCl and stir.
    - iii. Add  $20\text{cm}^3$  of water ( $\text{H}_2\text{O}$ ) to the mixture in the beaker and stir.
    - iv. Add  $20\text{cm}^3$  of ethanol to the solution in the beaker.
    - v. Filter the mixture to obtain the precipitate.
- Vi what are the observations during the different activities in ii, iii, and iv.

### Step II. Sharing:

- II. Teacher guides the students to discuss observations with group members as follows
  - i. Sodium chloride and iron (II) sulphate are both soluble in water.
  - ii. Green precipitate was obtained when ethanol was added to the solution.
  - iii. The formation of green precipitate is possible because  $\text{FeSO}_4$  is insoluble in ethanol.

### Step III: Process:

Teacher provides opportunities for students to reflect on the experiment by asking questions, facilitates students to relate experiences to the topic and explains the lesson.

- i. Teacher and students interact; ask/answer questions for clarification on the observations of the experiment.
- ii. The teacher explains the lesson in detail.
- iii. Students formulate meaning for the concept based on their experiences.
- iv.  $\text{Na}^+$  is soluble in ethanol to form sodium ethanoate while  $\text{Fe}^{2+}$  is insoluble in ethanol and so precipitated out due to differences in solubility in ethanol as a solvent..

### Phase IV: Application.

Students answer the following questions:

- i. State the principle behind the use of precipitation in separating mixtures?
- ii. What happened to the mixture of NaCl and  $\text{FeSO}_4$  when water was added?
- iii. Was that a separation technique? Why do you say so?
- iv. Mention any other separation technique apart from precipitation involved in obtaining green crystals.
- v. Teacher summarized the key points of the lesson on the board and marked students' notebooks

### Conclusion

The teaching of precipitation is more effective when students are active/engage in the learning process. The use of a step-by-step approach as demonstrated in exploratory-discovery strategy helped students to establish the link between theory and principle of using the separation technique. With the adoption of exploratory-discovery strategy, the students were deeply exposed to the concept before the teacher's explanation which made teaching and learning simple, interesting and meaningful as students learn through their own experiences.

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