IWS 2

A report comparing the effectiveness of spectroscopy, chromatography, and mass spectrometry for monitoring a specific environmental matrix (air, water, soil)

Deadline: February 24 – March 4, 2025 (week 6)

Objective:

To evaluate and compare the effectiveness of spectroscopy, chromatography, and mass spectrometry in monitoring pollutants within a specific environmental matrix (air, water, or soil), highlighting their advantages, limitations, and practical applications.

1. Introduction

- Overview of the selected environmental matrix (e.g., water).
- Importance of monitoring pollutants in the chosen matrix.
- Objectives of the comparison study and its relevance to environmental science.

2. Overview of analytical techniques

Spectroscopy:

- Describe principles of common spectroscopy techniques (e.g., UV-Vis, FTIR, Atomic Absorption).
- Key pollutants typically analyzed (e.g., metals, nitrates).

Chromatography:

- Explain Gas Chromatography (GC) and High-Performance Liquid Chromatography (HPLC).
- Typical applications (e.g., pesticide and pharmaceutical detection).

Mass Spectrometry (MS):

- Discuss standalone MS and combined techniques (e.g., GC-MS, LC-MS).
- Typical pollutants identified (e.g., volatile organics, complex organics).

3. Comparative evaluation criteria

- Sensitivity and detection limits.
- Specificity and ability to differentiate similar compounds.
- Sample preparation requirements.
- Cost and time efficiency.

- Practical considerations for field versus lab use.

4. Methodology

- Define how the comparison will be conducted
- Select specific pollutants (e.g., heavy metals, volatile organics, pesticides).
- Establish performance benchmarks (e.g., accuracy, precision).
- Simulate testing scenarios with real-world or spiked samples.

5. Results and Discussion

- Analyze each technique's performance
- Discuss combined techniques (e.g., GC-MS) for enhanced analytical capability

6. Practical implications

- Recommend techniques based on:
    - Type of pollutant.
    - Matrix complexity.
    - Available resources (e.g., lab infrastructure, expertise).
    - Considerations for regulatory compliance and routine monitoring.

7. Conclusion

- Summarize the strengths and weaknesses of each technique.
- Suggest optimal techniques or combinations for specific monitoring goals.
- Highlight areas for further research or technological improvement.

8. References

- Include a list of academic papers, standards, and technical manuals consulted for the report.

Appendices:

Detailed comparison tables.

Graphical representation of detection limits and accuracy across techniques.

SUMMATIVE ASSESSMENT RUBRICATOR
CRITERIA FOR ASSESSMENT OF LEARNING OUTCOMES

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Criterion	"Very good" 13-15	"Good" 10-12	"Satisfactory" 5-9	"Unsatisfactory" 0-4
Depth of comparison and analysis	The report provides an in-depth, well-structured comparison of spectroscopy, chromatography, and mass spectrometry, clearly explaining their principles, advantages, limitations, and suitability for the selected environmental matrix. The analysis is supported by relevant examples and evidence from credible sources.	The report includes a detailed comparison of the techniques with sufficient explanation of their principles, advantages, and limitations. However, some aspects may lack depth or specific examples.	The report offers a basic comparison of the techniques but lacks comprehensive analysis. Explanations are superficial, and the use of examples is minimal or absent.	The report fails to provide a meaningful comparison of the techniques, with little to no explanation of their principles, advantages, or limitations. There is no evidence or examples to support claims.
Relevance to the environmental matrix	The report effectively links each technique to its applicability for the specific environmental matrix (air, water, or soil), clearly justifying why a technique is suitable or unsuitable based on the matrix's characteristics.	The report relates the techniques to the environmental matrix, but the justifications for their suitability or limitations are general or not well-developed.	The report mentions the environmental matrix but does not effectively connect it to the choice of analytical techniques or provides weak justifications.	The report does not address the relevance of the techniques to the environmental matrix or fails to justify the connections altogether.
Clarity, structure, and use of sources	The report is well-organized, with a logical structure that enhances readability. Arguments are clear and concise, supported by accurate data from reliable and up-to-date sources. Citations and references are properly formatted.	The report is organized and mostly clear, but some arguments may lack coherence or conciseness. Sources are generally reliable but may lack variety or recency. Citations and references are present but may have minor formatting issues.	The report is somewhat organized but includes unclear arguments or repetitive information. Few sources are cited, or they may not be credible or relevant. Citation formatting is inconsistent.	The report lacks structure, clarity, and coherence. Sources are absent, unreliable, or irrelevant, and citations are missing or incorrectly formatted.