

A LIST OF RESEARCH PROJECT IDEAS FOR HIGH SCHOOL STUDENTS USING VIS SPECTROMETER

In this document, you will find 27 potential research ideas that your students can undertake using VIS spectroscopy. These examples serve as evidence that spectroscopy is an incredibly versatile, yet underutilized tool in high schools around the world. If you're interested in more in-depth experiments, please contact our team at info@paxia.co, and we will provide you with a workbook tailored for your classroom.

1. Food colorings absorbance spectra

Explanation: Students will measure the absorbance spectra of food colorings and their mixtures to understand how colors combine.

Science: Absorption spectroscopy, color mixing

Learning outcome: Understanding how different wavelengths are absorbed and how colors mix.

2. pH indicators and color change

Explanation: Students will analyze the color change of pH indicators in solutions with different pH levels. *Science:* Acid-base chemistry, pH indicators

Learning outcome: Understanding pH indicators and their application in determining acidity or alkalinity.

3. Concentration of dye in beverages

Explanation: Students will determine the concentration of dyes in colored beverages using the spectrometer. *Science:* Absorption spectroscopy, Beer-Lambert Law

Learning outcome: Understanding how to use absorbance measurements to determine the concentration of a substance.

4. Plant pigments absorbance spectra

Explanation: Students will extract pigments from plant tissues and measure their absorbance spectra. *Science:* Plant pigments, photosynthesis

Learning outcome: Understanding the role of pigments in plants and their absorption properties.

5. Beer-Lambert Law

Explanation: Students will prepare solutions of different concentrations and measure their absorbance to explore the Beer-Lambert Law.

Science: Absorption spectroscopy, Beer-Lambert Law

Learning outcome: Understanding the relationship between concentration, absorbance, and path length.

6. Temperature effects on absorbance

Explanation: Students will investigate the effect of temperature on the absorbance of a colored solution. *Science:* Absorption spectroscopy, temperature effects

Learning outcome: Understanding how temperature affects the absorbance of a solution.

7. Dissolved oxygen concentration

Explanation: Students will determine the concentration of dissolved oxygen in water using a colorimetric method.

Science: Dissolved oxygen, water quality

Learning outcome: Understanding the importance of dissolved oxygen in aquatic environments.

8. Effects of colored light on plant growth

Explanation: Students will grow plants under different colored light sources and observe their growth. *Science:* Photosynthesis, light absorption

Learning outcome: Understanding how different wavelengths of light affect plant growth.

9. Acid rain effects on water absorbance spectra

Explanation: Students will investigate the effects of acid rain on the absorbance spectra of natural waters.

Science: Acid rain, water chemistry

Learning outcome: Understanding the environmental impacts of acid rain on water quality.

10. Copper concentration in water

Explanation: Students will use a colorimetric method to determine the concentration of copper in water samples.

Science: Absorption spectroscopy, water quality

Learning outcome: Understanding the importance of monitoring copper concentrations in water.

11. Leaf senescence absorbance spectra

Explanation: Students will analyze the color changes in leaves during senescence.

Science: Plant pigments, leaf senescence

Learning outcome: Understanding the processes and factors involved in leaf aging.

12. Organic vs. synthetic dyes absorbance spectra

Explanation: Students will compare the absorbance spectra of organic and synthetic dyes.

Science: Absorption spectroscopy, dye chemistry

Learning outcome: Understanding the differences between organic and synthetic dyes and their absorbance properties.

13. Color Stability of Food Dyes in Different pH Conditions

Explanation: Students will investigate the color stability of food dyes by comparing their absorbance spectra in different pH conditions. *Science:* Absorption spectroscopy, dye chemistry, pH effects on color *Learning outcome:* Understanding how pH affects the stability and absorbance properties of food dyes and gaining experience with absorption spectroscopy.

14. Effect of pH on Anthocyanin Stability

Students will investigate the effect of pH on the stability of anthocyanins, which are natural pigments found in fruits and vegetables, by comparing their absorbance spectra in solutions of different pH levels. *Science:* Absorption spectroscopy, anthocyanins, pH effects on color *Learning outcome:* Understanding the impact of pH on anthocyanin stability

15. Absorbance stability of colored solutions

Explanation: Students will monitor the absorbance spectra of colored solutions over time to determine their stability.

Science: Absorption spectroscopy, chemical stability

Learning outcome: Understanding factors that influence the stability of colored solutions.

16. Nitrate concentration in water

Explanation: Students will use a colorimetric method to determine the concentration of nitrate in water samples.

Science: Absorption spectroscopy, water quality

Learning outcome: Understanding the importance of monitoring nitrate levels in water.

17. Comparing Pigments Extracted from Different Plant Species

Explanation: Students will extract and analyze pigments from various plant species using a VIS spectrometer.

Science: Absorption spectroscopy, plant biology, pigment extraction

Learning outcome: Understanding the differences in pigment composition among various plant species and gaining experience with absorption spectroscopy and pigment extraction techniques.

18. Effects of Water Pollution on Aquatic Plant Pigments

Explanation: Students will study water pollution effects on aquatic plant pigmentation by comparing absorbance spectra of extracted pigments from plants exposed to varying pollutant levels.
Science: spectroscopy, plant biology, water pollution, pigment extraction
Learning outcome: Understanding water pollution's impact on aquatic plant pigmentation

19. Invasive Species Impact on Local Water Quality

Explanation: Students will compare water quality from areas with invasive species to control areas using VIS spectroscopy.
Science: Absorption spectroscopy, ecology, water quality, invasive species
Learning outcome: Understanding invasive species' impact on water quality and gaining experience in water analysis

20. Fruit ripening and color changes

Explanation: Students will analyze the color changes in fruit skin during the ripening process.
Science: Plant pigments, fruit ripening
Learning outcome: Understanding the biochemical processes involved in fruit ripening.

21. Iron concentration in water

Explanation: Students will use a colorimetric method to determine the concentration of iron in water samples.
Science: Absorption spectroscopy, water quality
Learning outcome: Understanding the importance of monitoring iron levels in water.

22. Ammonium concentration in water

Explanation: Students will use a colorimetric method to determine the concentration of ammonium in water samples. Science: Absorption spectroscopy, water quality
Learning outcome: Understanding the importance of monitoring ammonium levels in water.

23. Tea polyphenol content

Explanation: Students will analyze the absorbance spectra of different types of tea to determine their polyphenol content.
Science: Absorption spectroscopy, tea chemistry, polyphenols
Learning outcome: Understanding the differences between various types of tea and their polyphenol content.

24. Cooking methods and vegetable absorbance spectra

Explanation: Students will compare the absorbance spectra of pigments extracted from vegetables that have been subjected to various cooking methods. Science: Absorption spectroscopy, plant pigments, food science, cooking methods
Learning outcome: Understanding the impact of different cooking methods on vegetable pigments

25. Vegetable oil absorbance spectra

Explanation: Students will compare the absorbance spectra of different types of vegetable oils. Science: Absorption spectroscopy, oil properties
Learning outcome: Understanding the differences between various vegetable oils.

26. Antioxidant Capacity of Fruit Juices

Explanation: Students will evaluate the antioxidant capacity of various fruit juices using a colorimetric method. Science: Absorption spectroscopy, antioxidant capacity, food science
Learning outcome: Understanding the concept of antioxidant capacity and its importance in food,

27. Solvent effects on dye absorbance spectra

Explanation: Students will investigate the effects of different solvents on the absorbance spectra of a dye.
Science: Solvent properties, dye chemistry
Learning outcome: Understanding how solvents can influence the absorbance spectra of dyes.