SN EDUCATOR GUIDE

November 6, 2021

Marie Antoinette's Letters Are Uncensored by X-rays

Student Discussion Worksheet

Directions: Read the online *Science News* article "Ink analysis reveals Marie Antoinette's letters' hidden words and who censored them" and answer the following questions as directed by your teacher. A version of the article, "Marie Antoinette's letters are uncensored by X-rays," appears in the November 6, 2021 issue of *Science News*.

Spectroscopy and atomic structure

1. Define and explain the process of spectroscopy based on what you learned from reading the *Science News* article. What type of electromagnetic radiation did researchers use to study Marie Antoinette's letters? What data comes out of using the spectroscopic technique?

2. What happens to the electrons in an atom when certain types of electromagnetic radiation or light interact with it? How does this behavior relate to your understanding of atomic structure?

3. How did spectroscopy allow scientists to distinguish two separate inks used on the letters? What can you infer about the relationship between elements' atomic structures and the spectra produced?

4. Draw a simple diagram of the process of X-ray fluorescence spectroscopy. Make sure you show the external light source, the ink and the result of the interaction. In another diagram, draw the light's interaction with an electron in one of the atoms in the ink.

More mysteries to solve

1. Brainstorm examples of other historical or scientific mysteries that could be solved using spectroscopy.

2. Beyond the information gathered using spectroscopy, what else would you need to know to solve one of the mysteries that you brainstormed?

3. Discuss what ethical issues exist around uncovering messages that were purposely concealed. What other ethical concerns should researchers consider when solving historical mysteries? What ethical concerns might you need to consider when solving one of the mysteries that you brainstormed?