

Hi! My name is Kylie Smith, and I'm a student at Purdue University. We are developing an inorganic chemistry laboratory experiment that introduces students to transition metal chemistry and coordination complexes through color changes. In aqueous solutions, metal ions usually exist in the form of coordination complexes. These are compounds in which the metal ion is surrounded by molecules or nonmetal ions called ligands. The properties of different coordination complexes (one of which is color) can affect their applications in biology, medicine, and industry, to name a few examples. Although we may not recognize it, iron complexes play a vital role in our everyday lives. Hemoglobin, the protein that carries oxygen in our blood, is an example of an iron complex. Oxygen attaches itself to the iron in the center of the complex, which carries it around through the blood to where it needs to go. The objective of the lab is that students will understand transition metal chemistry for some iron complexes, correctly prepare solutions, observe changes in the color and solubility of the iron complexes, and analyze metal-ligand formation for these complexes. One advantage of this experiment is that all chemicals can be reacted one after another in the same container. We started with an iron complex solution and added each subsequent chemical solution slowly, watching for complete color changes before moving on. The table and pictures of steps 2-13 on the poster summarize our observations. As you can see, each additional chemical solution caused either a clear color change or the formation of a precipitate, indicating that a new coordination complex had formed. We were then able to match each color change with a chemical equation representing the reaction happening at the time. This helps students relate the color change to concepts such as solubility and ligand displacement; for example, watching the solution turn from yellow to red in step 8 enhances students' understanding of how the change in the iron complex structure affects the way the solution reflects light. So how do we relate the structure of these complexes to their visual properties? The geometry of coordination complexes plays a large role in determining their properties and applications. The coordination number tells us the number of ligands that are bound to the central metal ion. This gives us an idea of the complex shape; for example, an iron ion with four ligands attached would have a tetrahedral shape. Some coordination numbers have several possible geometrical shapes associated with them. Another of the most important factors determining the properties of a coordination complex is the strength of the bonds between the metal and the ligands. The stability of the complex increases with the strength of the metal-ligand bonds. However, there are many other factors, such as pH and the hydration of the precipitate, that influence complex formation. In conclusion, this experiment teaches students about iron coordination complexes by allowing them to observe color changes and relate these to their knowledge of ligand displacement and solubility. Students' skills in solution preparation are also reinforced. This lab is currently being developed as an online laboratory experiment with added videos, multiple choice questions, and other interactive learning features.