General Chemistry Flipped Classroom Module

In-class Activity

"Thinking about Electron Configurations and Magnetism"

Introductory Leading Questions:

1) What are some applications of magnets?

2) Ideas about how magnetism is created?

Introduction:

Magnetic fields have important and varied applications in the real world. Magnets play an important role in areas such as medical imaging (Magnetic Resonance Imaging), the electronics industry (electronic displays, computer memory/storage), electric motors (e.g., electric motors for electric cars), and large-scale power generation (electromagnets and electrical generators).

Magnetic fields are created by moving electric charges, and high strength magnetic fields can be created when electrical current is passed through a coiled conducting wire. In this in-class activity, we will explore the connection between electrons and magnetic fields, become familiarized with how materials react differently to magnetic fields, and begin to think about how the electron configurations of different metals can help us predict (or not?) how these mateirals will behave in the presence of a magnetic field.

Group Learning Questions:

1) Write out the electron configurations for the following neutral atoms:

Fe, Ni, Al, Pt, Cu, Ag

2) Draw out the orbital notation for each and determine how many unpaired electrons are in each atom.

The magnetic properties of materials can generally be described as one of the following as described below.

a) Diamagnetic: materials that are repelled by magnetic fields or are unaffected by magnetic fields; these usually arise when the atoms/molecules in the material have most of their electrons spin-paired.

b) Paramagnetic: materials that are attracted to magnetic fields or can become magnetized temporarily by an external magnetic field, but which do not have persistent/permanent magnetic fields once the external magnetic field is removed; these arise when the atoms/molecules in the material have numerous unpaired electrons.

c) Ferromagnetic: materials that are attracted to magnetic fields and have a persistent magnetic field even when the external magnetic field is removed; these arise when the atoms/molecules have numerous unpaired electrons, and form because they possess a persistent state in which the unpaired electrons are aligned and create a strong magnetic field.

3) Metallic copper and metallic silver have been determined to be diamagnetic materials. Based on this observation, is it a requirement for atoms to only have spin-paired electrons present in order for a material to be diamagnetic?

4) If your answer to #3 is no, explain why/how copper or silver can be diamagnetic.

5) For the elements listed in #1, only iron and nickel are observed to be ferromagnetic. Given this observation, can you conclude that all atoms with unpaired electrons will produce materials that are ferromagnetic?

6) If your answer to #5 is no, provide possible explanations for why/how materials with unpaired electrons can be non-ferromagnetic.