Orbitals Undergoing Octahedral Crystal Field Splitting as Illustrated with LEGO® Bricks

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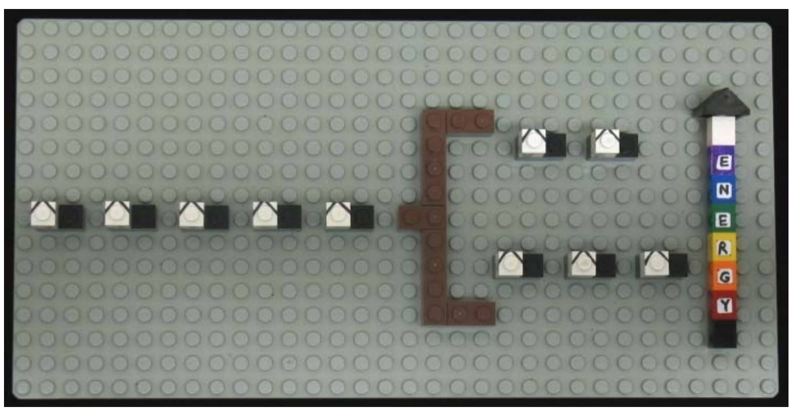
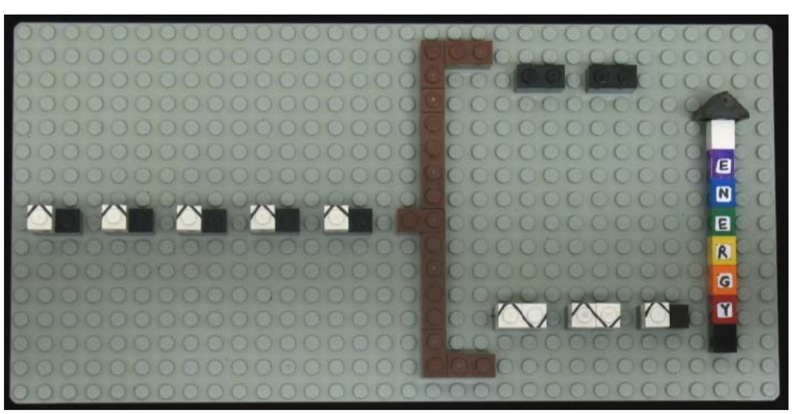
- Atomic orbitals can hold up to two electrons.
    - Orbital energy levels are represented by black 1x2 bricks.
    - Electrons are represented by white 1x1 bricks, arrows on the bricks represent electron spins.
- According to crystal field theory, octahedral ligands around a metal center splits the five metal d orbitals.
    - Two d orbitals are raised higher in energy than the other three d orbitals.
    - The energy difference between the higher energy and lower energy d orbitals is referred to as crystal field splitting.
- Electrons will tend to occupy the lowest energy orbitals first.
    - Lower energy is represented as lower positions on the energy diagrams.

- When the crystal field splitting is small, electrons are more likely to spread out among all the available orbitals (even ones that are slightly higher in energy than others) rather than pair up in orbitals.
- These arrangement is referred to as high spin, because of its relatively high number of unpaired electrons.



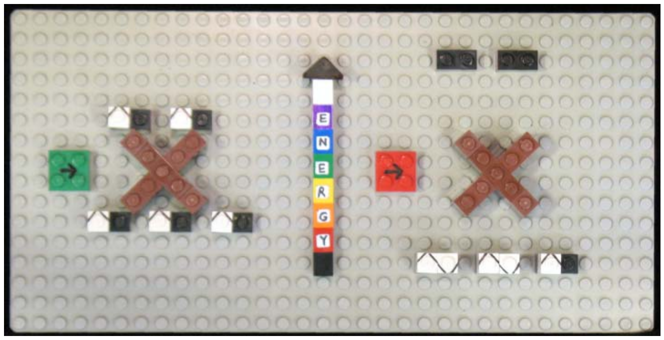
- When the crystal field splitting is large, electrons are more likely to pair up in orbitals rather than spread out among all the available orbitals.
- These arrangement is referred to as low spin, because of its relatively low number of unpaired electrons.



Atomic Orbital Interactions with Light

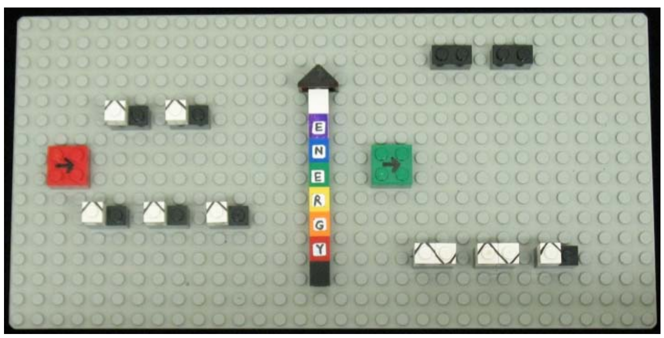
•Recall that the colors of light arranged in increasing energy are: red, orange, yellow, green, blue, and violet.

•High energy photons of light (represented by a green brick) have too much energy to promote electrons from lower to higher energy orbitals when the crystal field splitting is small.



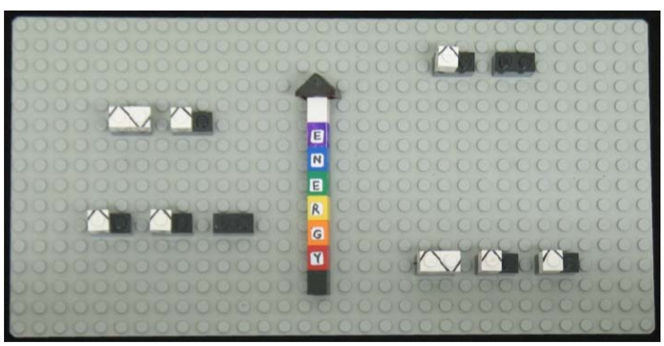
•Low energy photons of light (represented by a red brick) have too little energy to promote electrons from lower to higher energy orbitals when the crystal field splitting is large.

•Low energy photons of light (represented by a red brick) have the correct energy to promote electrons from lower to higher energy orbitals when the crystal field splitting is small.



•High energy photons of light (represented by a green brick) have the correct energy to promote electrons from lower to higher energy orbitals when the crystal field splitting is large.

•Examples of electrons that have been promoted into the higher energy orbitals.



•Electrons can move back from the higher energy orbitals to the lower energy orbitals by losing energy, either to re-emitted photons or to thermal energy.