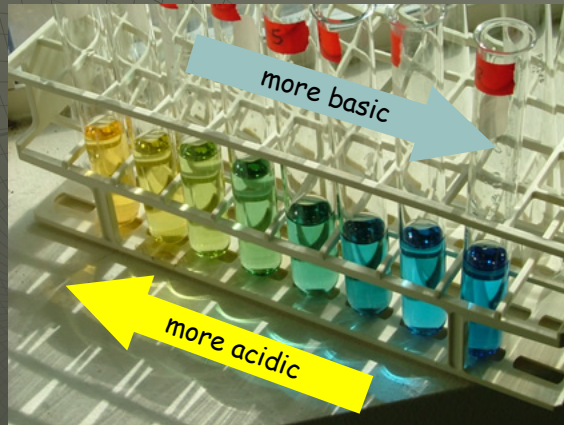
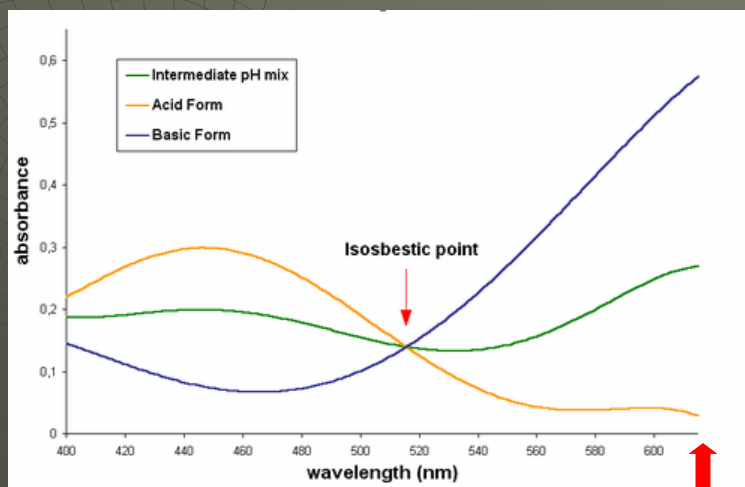


# BCG color



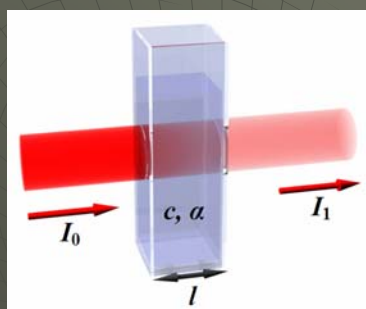
# pH-dependent spectrum



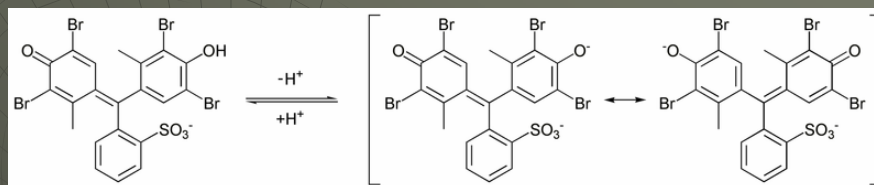
Measure Abs here

	$\lambda$ (nm)	$E = h\nu$ (kJ/mol)	typical bond
Red	630-700	41-45	F—F
Orange	590-630	45-48	Br—Br
Yellow	560-590	48-51	
Green	490-560	51-58	C—I
Blue	450-490	58-63	
Violet	400-450	63-72	C=C pi

## Absorbed $\neq$ Perceived



## Chemistry & Color



YELLOW

absorbs  
hi E photons  
(450 nm)

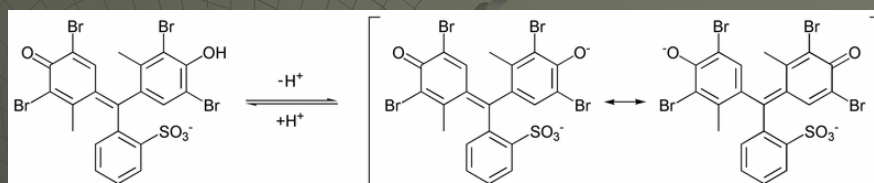
BLUE

absorbs  
low E photons  
(620 nm)

Photon E changes electron location & motion. How can we explain this?

## Lewis (resonance)

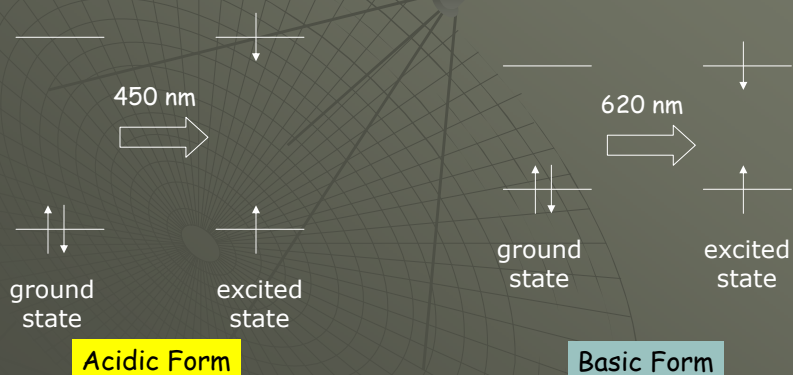
- ◆ How do you draw *excited state*?



- ◆ Rule of Thumb = more "extended conjugation" → lower E transition

## Orbital Transition

◆  $E_{\text{photon}} = E_{\text{empty orbital}} - E_{\text{filled orbital}}$



Acidic Form

Basic Form

## Bond Orbitals

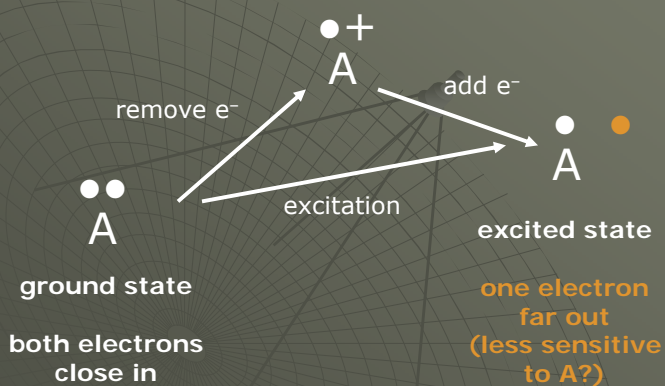
- ◆ Each electron pair fills a "local" orbital
  - ◆ Covalent bond → bond orbital
  - ◆ Lone pair → atomic/hybrid orbital
- ◆ Also unused (empty) orbitals
  - ◆ Antibond orbitals + very high E atomic orbitals
  - ◆ Used if electrons absorb energy
- ◆ Orbital energies
  - Bond ( $\sigma < \pi$ ) < Lone pair << Antibond ( $\pi < \sigma$ )



## Bond Orbitals

- ◆ Acidic BCG contains OH (neut LP)
- ◆ Basic BCG contains  $O^-$  (negative LP)
  - ◆ More e-e repulsion means electrons held more loosely  $\rightarrow$  easier to excite
- ◆ Possible problems
  - ◆ Same excitation for acidic & basic BCG?
  - ◆ Charge doesn't affect empty (antibond) orbital energy?

## Excitation = 2 Ionizations



Basic BCG = Dianion  
much easier to "remove e<sup>-</sup>"  
"add e<sup>-</sup>" more like Acidic BCG

# Molecular Orbitals

- ◆ Test w/ computer

