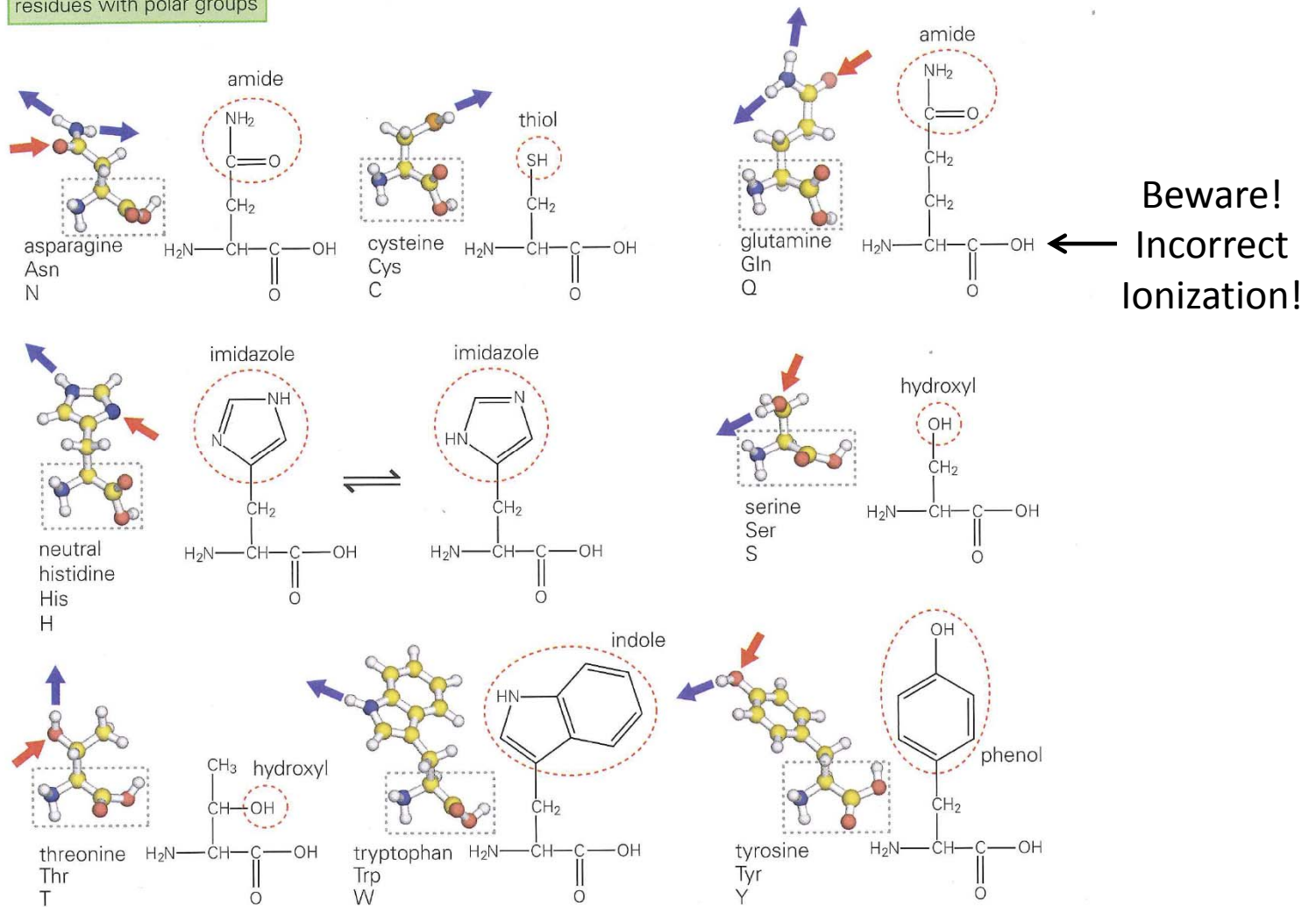


# Polar Amino Acids

(side chain is uncharged at neutral pH, can donate or accept hydrogen bonds)

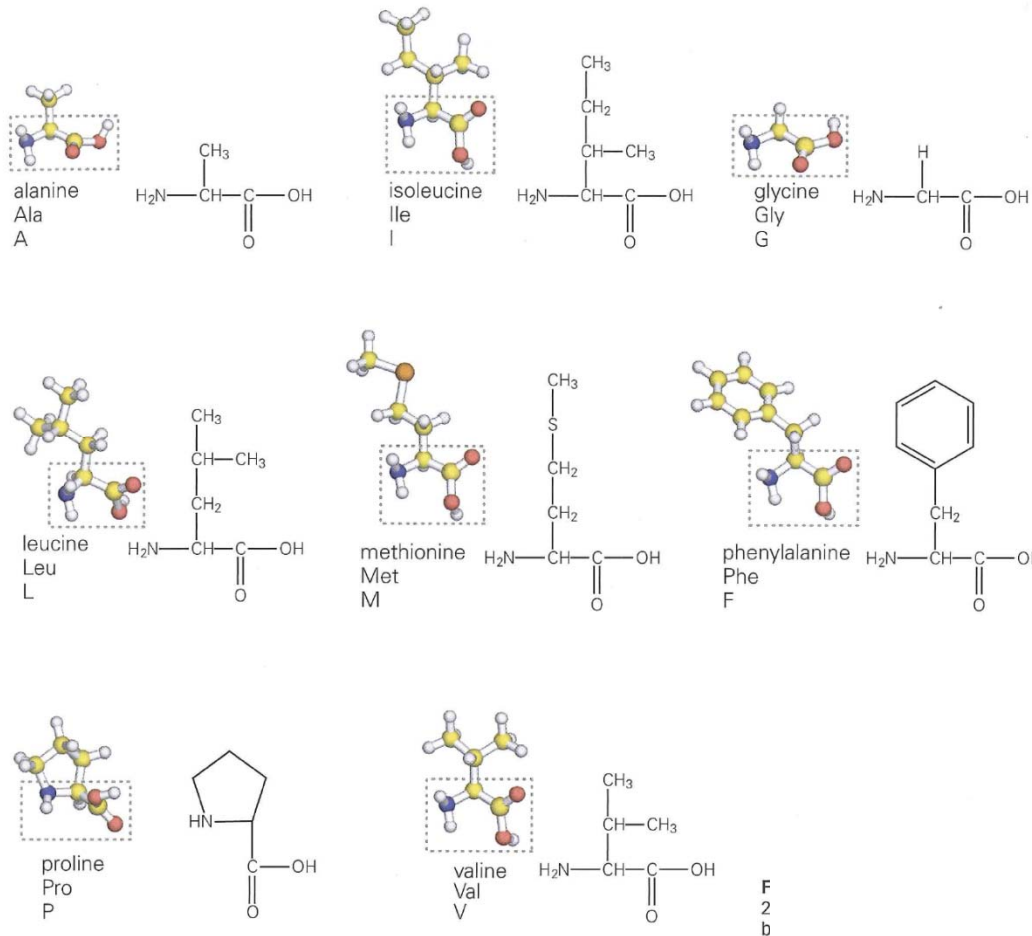
residues with polar groups



# Nonpolar Amino Acids

(side chain is uncharged at neutral pH, cannot participate in hydrogen bonding)

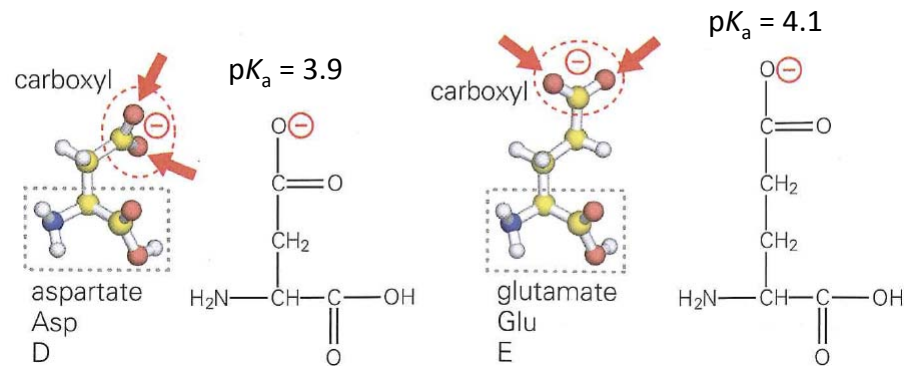
nonpolar, hydrophobic residues



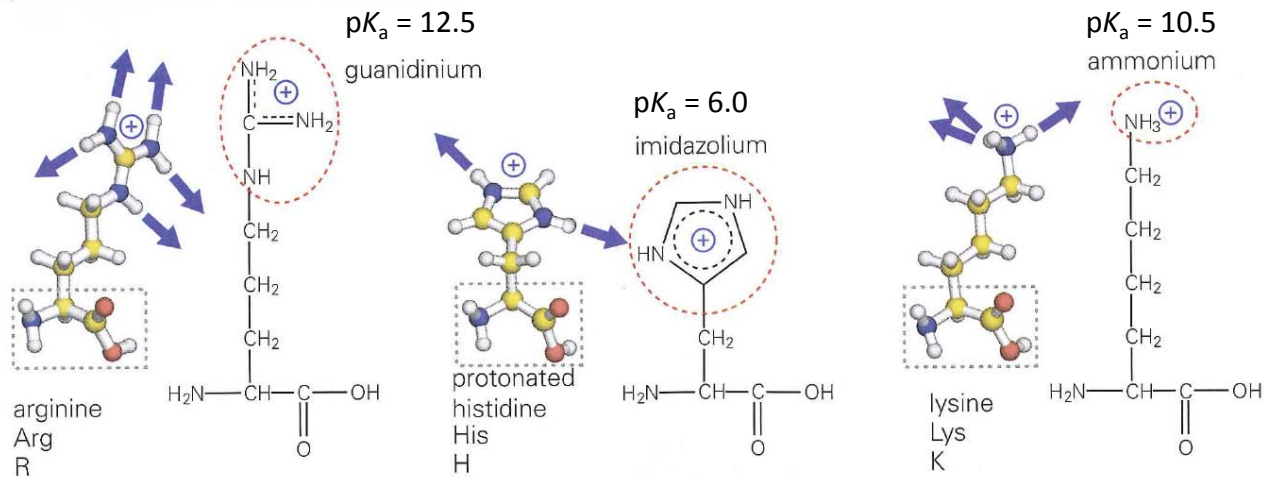
# Ionizable Amino Acids

(with typical side-chain  $pK_a$  values, charged at neutral pH)

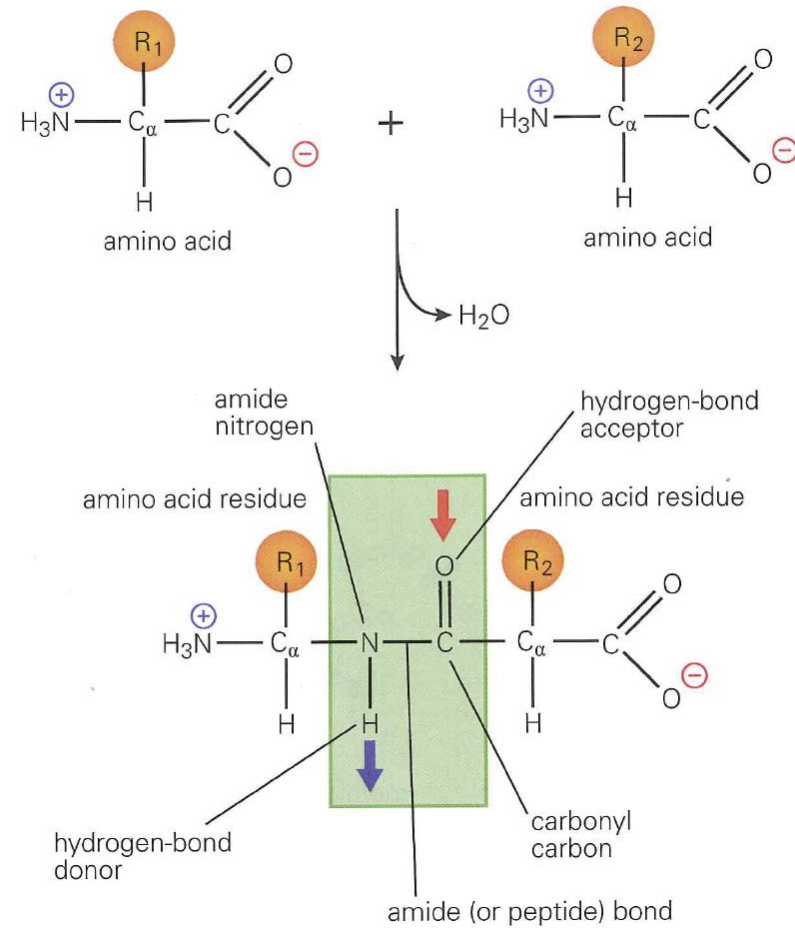
negatively charged, hydrophilic residues



positively charged, hydrophilic residues



# Making Peptide Bonds: Condensation



# Expectations: Amino Acids

- Structures memorized
- Three- and one-letter codes memorized
- $pK_a$  values do *not* need to be memorized
- Structure of protein backbone memorized

**Example:** Draw the structure of GDEF at neutral pH.