BCH 258 lecture notes  Wed. Sept 08, 2010 revised Structural Motifs and Domains

Homework:
- Reading Suggestion: Chapters 2 - 5 in Branden & Tooze
- WorkSheet5-Structural Classes: (preparation for Coloring Book)
- Coloring Book: due Wed. Sept 16

c2Motifs.kin, c3Alpha.kin, c4Al_Bet.kin, c5Beta.kin

In class:
revisit with Kendrews: Helix N-cap – residue half in & half out of helix: e.g. Asn

Structural Motifs: small, favored clusterings of 2-4 pieces of sec. str.; strong
  General preference for contact of near neighbors in sequence

  Helix hairpin: successive ↑↓ helices; pack best at ~15-20° angle
  Hydrophobic patches; spiral ridges of sidechains; coiled-coil
  ~90° helix contacts: “EF hand” Ca++-binding; “helix-turn-helix” DNA-binding

  β-hairpin: successive ↑↓ β strands; shortest with tight turn

  crossover or βαβ connection: successive ↑↑ β-strands
    >>99% righthanded; determines architecture of α/β folds

  Greek key β:

    SS β-cross: 2 touching SS spirals (1L,1R) on adjacent β hairpin strands

Domains, defined in terms of contained motifs

Structural Domain (the unit of tertiary-structure description, or “fold”)
  Local region in 3D with presumption of (or better score for) contiguous sequence
    (beware alternate definitions: 3D & sequence, or just sequence)
    (Note: “domain swap”: part of a domain swapped with a neighbor)
  Independently stable; may move as a rigid body
  Analogous structure to other entire protein (or plausible as such)

Major categories of tertiary structures (many “folds” in each category)
  I.  All-α (chap. 3)
  II. α/β  (chap. 4)
  III. All-β  (chap. 5)
    +.  Small irregular; mixtures; miscellaneous

(Alternative scheme: “Superfolds”)
  Commonest “folds” with same topology & shape in “core” part,
  Found in ≥ 3 unrelated protein families
α – motifs: helix-helix contacts; Hphobic patches; pack spiral ridges of sidechains
   Helix hairpin: adjacent, ↑↓ pair of α; +15-20°; form helix bundles
   EF hands, helix-turn-helix: adjacent pair ~90°; Ca ++ binding, DNA binding

Small irregular motifs:
   Zn finger in metal-rich (several kinds; bind DNA)
   SS β cross in SS-rich: 2 crossed SS’s, from β hairpin

α/β motifs: righthanded crossover, or βαβ unit
   its alternation of β & α, and its handedness, dominates α/β folds

α/β superfolds:
   singly-wound β-barrel, = TIM barrel, or = (βα)₈ barrel
   α/β horseshoe
   doubly-wound β-sheet, = twisted open sheet, or = nucleotide-binding domain
   the commonest protein fold, esp. for enzymes
   active or binding site at “switch point”

β motifs:
   β hairpin (2 ↑↓ strands)
     Greek key +1, -3; long β-hairpin coiled around,
     Handed (ccw from outside)
     twist of double ribbon (belt) becomes loops around "barrel" ends
     axis of barrel along strand direction,
     barrel closed by H-bonds of edge strands
     some quite round, some flattened:
     described as 2-layer "sandwich"

β superfolds:
   up & down β-barrel (& β-trefoils)
     Greek key β-barrel 6 or 8 strands, & “jellyroll” >8 strands
     open-face sheet
     β-propeller
     parallel β-helix
Coloring Book
In the Protein Structure Coloring Book (class hand-out), pick one α/β protein and one All-β protein to color, using any system that interests you and that makes sense relative to the 3D structure; hand in those two. [Note that the coloring book includes All-α and Small Irregular proteins as well.]

Graphics: Coloring Book Slides (shown in class) [slide_archive/ribbons etc/]
11. GammaCrystallinJane.jpg   barrel fold
12. GammaCrystallinCyrus.jpg sheet sandwich
13. GammaCrystallinTom.jpg  evolution, gene duplications
22. BPTISSluminated.jpg     β sidedness, SS
31. SODpastel.jpg           depth
32. TIMpastel.jpg           depth and sec. str.
41. IggVLcolorBkice.jpg     simple topol.: connections: GK vs hairpin
43. CAPgreekKeyPair.jpg     simple: GK pair
45. CPAspider_Duncan.jpg    complex: sec. str., sided, ~H-bonds, etc.