Lecture 9 – Biochemistry of Synapses – D. Goldberg

I. Presynaptic
  A. General Considerations
    1. criteria for being transmitter
      a. synthesized by cell
      b. present at terminal and released in sufficient amounts
      c. exogenous application mimics presynaptic stimulation
      d. mechanism for removal from synaptic cleft
    2. two types of transmitter
      a. small molecule
        i. synthesized at terminal and can be rapidly replenished
        ii. rapid or modulatory postsynaptic effects
      b. peptide
        i. from precursor protein synthesized in cell body
        ii. mainly modulatory postsynaptic effects
  B. Small Molecules
    see table
  C. Peptides
    1. cleavage from precursor allows amplification, multiple outcomes from single gene
  D. Co-existence
    1. small molecule and peptide transmitters present together in some terminals
    2. unclear whether Dale's Principal that all terminals of a neuron release the same transmitter(s) is true

II. Postsynaptic
  A. Receptors
    1. ionophoric
      a. rapid conformational change
      b. mediates transmission
    2. metabotropic (coupled to second messenger)
      a. slower biochemical steps
      b. modulates transmission
      c. accesses second messenger via serpentine receptor which activates G protein
      d. active G protein splits into subunits which affect enzymes or ion channels
      e. 3 major second messenger pathways: cAMP (protein kinase A), IP_3 (Ca^{++})/diacylglycerol (PKC), arachidonic acid
      f. reasons for using second messenger pathway
        i. long-lasting effect
        ii. signal amplification
        iii. signal divergence from one receptor to multiple targets
        iv. signal convergence from multiple receptors to one target
        v. spread of signal through cell
        vi. regulation of gene transcription

Relevant reading: chapters 13 and 15 in "Principles"