Achievable

USMLE STEP 1 DUMP SHEET

Cell and molecular biology

Organelles

- **Ribosomes:** 40S binds mRNA; 60S has peptidyl transferase
- **RER:** secretory, lysosomal and membrane proteins
- **SER:** steroids, detox (P450), glucose 6-phosphatase
- **Golgi:** cis receives, trans ships; tags lysosomal enzymes with mannose 6-phosphate
- **Lysosomes:** acid hydrolases; antigen for MHC II
- **Peroxisomes:** catalase; very long chain fatty acid β-oxidation; Pex defect: Zellweger
- **Signal recognition particle:** N-terminal signal sequence to RER
- **Ubiquitin:** tags misfolded proteins for the proteasome

Nucleus and transcription

- **Nucleolus:** assembles ribosomes
- **Euchromatin:** open, active; histone acetylation
- **Heterochromatin:** condensed, silent (Barr body); DNA methylation
- **RNA polymerase II:** mRNA; promoter TATA, CAAT, GC boxes
- **Enhancers** raise and **silencers** lower transcription, near or far
- **Processing:** 5' 7-methylguanosine cap, 3' poly-A tail, splicing
- **Spliceosome snRNPs:** remove introns; anti-snRNP in SLE
- **Telomeres:** TTAGGG repeats lost each division; telomerase restores them

Genetic code and mutations

- **Codons:** 61 sense; stop UAA, UAG, UGA; start AUG (Met)
- **Degenerate:** wobble at the 3rd base; unambiguous, universal
- **Missense:** new amino acid (sickle cell: Glu to Val, codon GAG to GUG)
- **Nonsense:** premature stop. **Frameshift:** indel not a multiple of 3

Translation

- **Sites:** A (aminoacyl-tRNA), P (peptide chain), E (exit); Met-tRNA starts at P
- **Aminoacyl-tRNA synthetase:** charges tRNA and proofreads
- **Glycosylation:** N-linked (Asn) in ER; O-linked (Ser, Thr) in Golgi
- **Hydroxylation:** proline, lysine (collagen). **Carboxylation:** glutamate (vitamin K factors)

Cell cycle

- **Cyclin-CDK:** D-4/6 (G1), E-2 (G1/S), A-2 (S), B-1 (M)
- **Rb:** holds E2F at G1/S; phosphorylated Rb is inactive
- **p53:** DNA damage halts G1 (p21) or triggers apoptosis; MDM2 keeps it low
- **HPV:** E6 inhibits p53, E7 inhibits Rb
- **ATM:** double-strand breaks (ataxia telangiectasia). **ATR:** UV damage. Both stop cells at G2 by blocking cdc25C

Signal transduction

G protein	Enzyme	Second messenger	Effect
Gs	Adenylyl cyclase up	cAMP up	Protein kinase A
Gi	Adenylyl cyclase down	cAMP down	Opens GIRK K^+ channels: hyperpolarizes
Gq	Phospholipase C	IP3, DAG	IP3 releases ER Ca^{2+}; Ca^{2+} and DAG activate PKC

- **PDE** degrades cAMP; theophylline, caffeine inhibit it
- **Tyrosine kinase receptors** (insulin, EGF, PDGF): Ras to MAP kinase
- **PI3K/Akt:** PIP3, Akt blocks apoptosis; **PTEN** (Cowden) undoes it
- **Anti-EGFR:** erlotinib, gefitinib; cetuximab, panitumumab

Cancer genes

- **Oncogene:** one allele (gain). **Suppressor:** both alleles lost

Gene	Tumors
ERBB2 (HER2)	Breast, ovarian, stomach
BCL2	Follicular lymphoma
MYC	Burkitt lymphoma; **MYCN**: neuroblastoma
RAS	Lung, pancreas, colon
APC	Familial polyposis
TP53	Li-Fraumeni
RB1	Retinoblastoma, osteosarcoma
MLH1, MSH2	HNPCC (mismatch repair)

Tumor markers

- **Invasion:** E-cadherin lost; metalloproteinases; VEGF

Marker	Tumor
CEA	Colorectal, pancreatic
AFP	Hepatocellular, yolk sac
CA 125	Epithelial ovarian
CA 19-9	Pancreatic
hCG	Choriocarcinoma
PSA	Prostate
5-HIAA	Carcinoid
Metanephrines	Pheochromocytoma