Cell Structure

- 0.1-700uM
- Coccus, Rod, Spirillum, Spirochetes, Budding, filamentous
- MreB, CreS, FtsZ
- Opanoids not sterols
- Archaea → ether linked glycerol, not fatty acids, hydrocarbon tail made of isoprene, monolayer = resistance
- Simple transporters(Lac permease), Group translocators(PEP), ABC(periplasmic binding) transport

Cell Wall

- Gram+ → Thick PG, Peptide bond direct crosslink, Teichoic acids, dye stayed
- Gram- → Thin PG, Outer membrane, periplasm, glycosylated (LPS), Peptide interridge(5-Gly), dye washed away
- N-Acetyl-Glucosamine(NAG), N-Acetyl-Muramic Acid(NAM), B1,4 glycosidic
- Variants in 3rd amino acid, or crosslinking type
- Teichoic acids in gram+, LPS and periplasmic space In gram-
- Acid Fast → mycobacteria, basal layer outer, outer= PG and arabinogalactan, osmotically controlled variants
- Archaea → pseudo-PG (NAT-NAG) , S-layer, Porin-like

Biogenesis

- Fruc-6-P modified → NAG →joined to UDP → MurB changed to NAM-UDP → Mur(C,D,E,F) add amino acids
- Bactoprenol flips NAM/NAG outside cytoplasm
- Trans glycosylation NAG joined to NAM by removing UDP (by HMWPBP)
- Transpeptidation bridge is formed by PBP
- Autolysins → cleave B1,4 bond, Amidases → remove amino acids chains

Appendages and Motility

- Fimbriae and Pilus → gram-, biofilms, pathogenicity, conjugation
- Twitching → Pilus IV by PilQ/C Atpase
- Gliding → no pilus or flagella, ex. Focal adhesion on MreB
- Flagella → Filament, Cap, Hook, Basal body(L/P/MS/rings, rod, MotA/B, C), proton motive force, no L/P in Gram+
- Biogenesis → Basel body exported, hook exported through BB, filament extended (hollow), has checkpoints
- Swimming → CCW = Run, CW = Tumble
- Swarming → Social, hyperflagellated
- Endoflagella in spirochetes → corkscrew spinning
- Archaea flag → Not hollow, synthesized from base, use ATP not PMF
- Taxis → Chemo/Photo/Aero, attractant/repellent, Methyl/phospo, temporal > special, localization, removal

Metabolism

- Carbon source → Autotrophic/CO2, Heterotrophic/Sugars, symbiotic relationship
- Photoautotrophic-Chlorophyll, Chemoautotrophic-Oxidation
- Heterotrophic + chemoautotrophic → chemoorganotrophic
- Electron carries (coenzymes) eliminate redox direct contact
- Glycolysis: glucose → 2 pyruvate, 2 H20, 2 ATP, 2 NADH, 2 H+, Investment/Payoff
- Fermentation: Hexose forms- Alcoholic → ethanol+CO2, Lactic → Lactate, regenerates NAD+ , 2 ATP total
- Citric Acid Cycle: oxidation of Gluc→ CO2 produces 3 CO2, 4 NADH, FADH2, GTP
- Carbons of CaC → 2, 6, 6, 6, 5(NADH), 4(NADH), 4,(GTP), 4(FADH2), 4, 4(NADH) as Oxalacetate
- ETC: C1(NADH, 4+), C2(FADH2, 2+), Q-cycle, C3(Cytbc1)→CytC→C4(2+, O2→H2O)
- ATP-synthase: oxidative phosphorylation, 38 ATP per Gluc, reversibility
- Anaerobic → Nitrate reduction(Nitrate to Nitrite, or Dinitrogen Gas), Methanogenesis(CH4, only archaea)
- Anabolism → Glucogenesis (reverse glycolysis), Krebs produces Amino Acids

Bacterial Growth

- Binary Fission, Doubling time
- Colonies, Turbid suspension, biofilms
- Media → selective, complex, minimal, enriched
- Growth, growth rate, generation time
- Direct count, viable count, turbidity
- Growth phases, Diauxic growth curve, chemostat

Factors

- Macro/Micronutrients
- Temperature, cardinal temperatures, (Psychro, Meso, Thermo) obligate or facultative
- Osmolarity (Halotolerant, halophile)
- Oxygen (Aerobe, aerotolerant, microaerophi, facultative anaerobe, obligate), Reactive species, catalase, oxidase
- pH (acidophile, neutrophile, alkophile)

Controlling

- Decontamination, disinfection, sterilization
- Heat, autoclave, pasteurization, ionizing, non-ionizing, filtration, antiseptic safe

Antibiotics

- Selective toxicity, Disc diffusion, E-Test diffusion,
- Cell wall(B-Lactams(PBP), Vancomyosine(D-Ala), Transcription(Sigma, T-RNA), Metabolism(Similar structure)
- Antibiotic resistance, MDR strains, plasmids
- Reduced permeability, Inactivation, Modification of target, Efflux, New pathways, Phage therapy

Genomics

- Supercoiling, NAPs, Gyrase
- Highly efficient
- Operons, core genome, pangenome
- Plasmids, mega plasmids, chromid, covalent attached ends, incomparability groups
- Transposons, Dr→IRtransposaseIRDR, Non-composite, Composite, Target sequence(4-8)
- Conservative → DS cut
- Replicative → SS Cut
- Evolution role with HGT

Mutations/Repair

- Spontaneous, induced, micro/macro lesions, transition/transversions, nonsense, missense, reversion, suppressor
- Hypermutable strains, Ames test, fluctuation test
- Photolyase → direct reversal P-dimer
- NER → UvrAB detects, A releases, UvrC bonds and cuts, UvrD helicase, Pol I and ligase
- BER→ Glycosylase cuts, AP site formed, Ap-Endonuclease recognizes and nicks, Pol I fixes
- Mismatch repair → MutS recognizes, MutH cuts unmethylated strand, UvrD opens, Pol I fixes
- SOS → DNAP V activated by RecA
- HR → RecA binds ssDNA and drives ssDNA into dsDNA until homologous region found, tsDNA forms a holiday junction, RuvA/B stabilizes, RuvC resolves, cleavage plane determines crossing over or not

Horizontal gene transfer

- Transformation → competence(quorum, electroporation), ssDNA uptake, RecA homologous recombination
- Conjugation → Sex pilus, F-Plasmid rolling circle insertion, OriV or OriR, HFR, F+/F-, F'
- Transduction → General-Any gene, specialized-specific genes, Λ and Gal

Gene regulation

- Constitutively expressed vs regulated
- RNAP holoenzyme → B, B', 2A, Sigma
- Terminators → Rho dependent, Rho independent(stem loop, poly U)
- Alternative Sigma →Sigma70/RpoD, RpoH, RpoN, RpoS, Expression level and Affinity
- Promoter competition, Collision, blocking, sitting duck
- Regulatory proteins → homodimer, palindromic sequences, helix-turn-helix
- Repression → Anabolic pathways, operator, corepressor, physically block
- Induction → bound and repressing unless catabolite present, induced repressors
- Activators → upstream, increase affinity or twist DNA, often needs a co-activator
- Dual Function → AraC
- Antisense RNA (sRNA) → positive (blocks degradation) or negative (blocks RNAP)
- Riboswitches → feedback inhibition, RNA binding, prevent translation or induce transcription termination
- Attenuation → co-translational, leader peptide followed by attenuator
    - Trp Attenuator → antiterminate (23, slow, low Trp) terminator (34, fast, high Trp)
- Regulons, global regulation, signal transduction, Maltose regulon
- Lac operon → lac repressor, CAP and cAMP(co-inducer)
- Quorum sensing → thresholds effect, gram- diffusion, gram+ peptide signal binds receptor

Viruses

- Capsid self-assembling, repeating subunits called capsomers
- Helical, Complex (head and tail), Enveloped (phospholipid, proteins from host)
- Baltimore → 1)dsDNA 2)ssDNA 3) dsRNA 4) ssRNA(+) 5) ssRNA(-) 6) ssRNA(+) retrovirus
- Reverse transcriptase, overlapping genes(phages)
- T-Series → 1 stage growth, latency-lytic release phage, Early, Middle, Late genes
- Phage immunity from lack of receptors,
- Λ → complementary single strand loop forming, bidirectional then rolling(for packaging), concatemer
- T4 → Tail protein assembled on base plate, packaged into head with ATP, terminal redundancy
- Spo1 → Sigma factors inserted, middle sigma, late sigma
- Filamentous Phages → no lysis
- Temporate phages → lambda, lytic vs lysogenic, induction, Cro vs CII