Lecture1 DNA structure and function

- **Chargaff's Rules:** the amount of adenine nearly always equaled the amount of thymine; the amount of cytosine nearly always equaled the amount of guanine.

Lecture2 Chromosomes, chromatins and the nucleosome

- **Chromosome:** A chromosome is an organized structure of DNA and protein that is found in cells. It is a single piece of coiled DNA containing many genes, regulatory elements and other nucleotide sequences.
- **Chromatin:** the complex of DNA and protein, which makes up chromosomes. Two forms: euchromatin and heterochromatin.
- **Nucleosome:** A structure with DNA wrapped around a core of histones. fundamental repeating units of eukaryotic chromatin, pack the huge genome into nucleus.
- **Histone octamer:** H2A H2B H3 H4 (no H1), package DNA into the nucleosome, and provide a regulatory site.
- **Heterochromatin:** a form of tightly-coiled chromosomal material that carries genes, and is largely inert genetically (inactive in transcription).
- **Euchromatin:** a form that lightly-coiled and is active in transcription.
- **Centromere:** at the middle of a chromosome where two chromatids bind together, involved in the mitosis and miosis. Contains specific types of DNA sequences (tandem repetitive sequences)
- **Kinetochores:** link to the spindle during the cell division.
- **Telomere:** a repetitive DNA sequence at the end of the chromosome, protect the chromosome

Lecture3 DNA Replication

- **Central Dogma:** the heritage information transferred from DNA to RNA to Protein.
- **replication fork:** during DNA replication, the double helix unwinds and form a "Y" shape
- **origin of replication (Ori):** a sequence where DNA replication start
- **primosome(引发体):** a protein complex of primer and helicase, which is used to help primer bind to DNA.
- **Replicon:** a DNA sequence that synthesizes from the start of the replication and finally finished by the replication fork.
- **Replication bubble:** the double helix separate then forms two replication forks. Bubble is between these two forks.

Lecture4 Transcription

- **RNA:** a polymer that composed by alternating units of ribonucleotides.
- **rRNA:** ribosome RNA which composed by RNA and protein and used for synthesize the protein.
- **tRNA:** Transfer RNA, carries the amino acid and read the codon on the mRNA through its own anticodon.
- **mRNA:** the RNA that transcribed from DNA and contains genetic information for protein synthesis.

- **Transcription bubble**: the double helix separate then forms a circular opening, where transcription starts.
- **Promoter:** DNA sequence that is responsible for binding to RNA polymerase, and start transcription.'
- **CTD:** carboxyl-terminal domain, on the RNAP2 which related to the mRNA splicing.

Lecture5 Translation

- **Alleles:** the same gene in the same location, but with minor nucleotide changes that produce slightly different protein.
- **Diploid:** have 2 copies of each gene and chromosome.
- **Codons:** The protein-coding region of the mRNA consists of an ordered series of 3-nt-long units
- **ORF:** opening reading frame, the protein coding region of each mRNA, composed by non-overlapping and continuous codons.
- **RBS:** ribosome binding site, in prokaryote, a sequence on the mRNA which binds to ribosome.
- **SD sequence:** equal to RBS!!!
- **Kozak sequence:** in eukaryote, before the start codon, can increase the translation efficiency.
- **Ribosome cycles:** when translation starts, the small and large ribosome subunit associate, and dissociate after translation.
- **Polyribosome:** an mRNA can bind several rRNA.
- **Polycistronic:** one mRNA can encode more than one protein, in prokaryote
- **Monocistronic:** one mRNA can only encode one protein, in eukaryote

Lecture6 the Genetic Code

- **Synonyms(同义密码子):** different codons encode for specific same amino acid.
- **Cell-free system:** amino acid can be synthesized artificially without cell.
- **Code degeneracy:** the third nucleotide can always be changed and still encode the same amino acid
- **Transition(转换):** in the third position of a codon specifies a same amino acid.
- **Transversion(颠换):** in this position changes the amino acid about half the time.
- **Missense（错义）mutation:** An alternation that changes a codon specific for one amino acid to a codon specific for another amino acid.
- **Nonsense 无义 or stop mutation:** An alternation causing a change to a chain-termination codon
- **Frameshift (移码) mutation:** Insertions or deletions of one or a small number of base pairs (not a factor of 3) that alter the reading frame.
- **Revertant（回复）mutations:** change an altered nucleotide sequence back to its original arrangement.(at same site) (1)Intragenic 基因内的 suppression (2) Intergenic 基因间的 suppression
- **Suppressor mutations:** suppress the change due to mutation at site A by producing an additional genetic change at site B.(B 抵消 A)
- **Wobble:** 5' end of the anticodon is not specifically paired to the 3' end codon.

Lecture8 Gene Expression and Regulation in Prokaryotes

- **House keeping gene:** expressed continuously, essential for basic processes, involving in replication and growth.
- **Inducible gene:** expressed only when they are activated or de-repressed.
- **Operon:** a unit of prokaryote gene expression and regulation, which includes: structure gene, control element, regulatory gene.
- **Cis-Acting Element:** a DNA sequence that can bind to TRANS and regulate gene expression.
- **Trans-Acting factor:** a protein that can recognize and bind specifically the CIS and regulate the gene expression.
- **TAD:** Transcription-Activation Domain, on the trans-factor, which bins to RNAP to increase the efficiency of transcription.
- **DBD:** DNA Binding Domain, on the trans-factor, which binds to a specific DNA sequence (cis)

Lecture9 Gene Expression and Regulation in eukaryotes

- **Promoter:** A regulatory region of DNA generally located at the 5' region of the antisense strand of a gene that promotes transcription
- **Enhancer:** Regulatory cis-elements to which activators bind to enhance the rate of transcription.
- **Insulator**: a cis element that prevents a gene from non-specifically influenced by the activation (or repression) of its neighbors.
- **Silencer:** a control region of DNA that when bound by TFs, can repress gene expression.
- **Coactivators:** protein that binds enhancer binding protein and TF together.
- **CTCF**: CTC Factor, a trans-factor (protein), that binds to insulator.
- **PIC:** pre-initiation complex, a large complex of protein that is necessary for the transcription in eukaryote.
- **DNA looping:** when enhancer works, it should be close to the promoter, so the DNA loops to make sure the enhancer and promoter can interact.

Lecture10 Gene Genome & Genomics

- **DNA:** A linked chain of deoxyribonucleotides. The double helix is composed of two DNA strands.
- **Gene:** a segment of DNA on a chromosome that codes for a specific protein and thus determines the trait, a unit of inheritance
- **Exon:** the expressed part of DNA
- **Intron:** the intervening, not expressed.
- **Alternative splicing:** pre-mRNA can be spliced in many ways thus produces several different mature mRNA.
- **PTM:** Post-translational modification, the protein is dynamic that can be modified in many ways.
- **Transposons:** jumping gene, DNA elements that can change positions.
- **Gene Clusters:** many genes are arranged in groups of related genes along chromosome.
- **Gene Families:** Related genes may be organized in several clusters at different locations.
- **Frame shift mutation:** deletion or insertion one nucleotide results shifting of the reading frame of an mRNA

- **SNP:** *single nucleotide polymorphism*, a single nucleotide differs between people, which creates diversity
- **Genome:** entire organism's hereditary information.
- **Genomics:** is molecular characterization of whole genomes.
- **Structure genomics:** characterizes the physical nature of whole genomes.
- **Comparative genomics:** compare the genome among different organisms.
- **Functional genomics:** describe the gene functions and interactions.
- **Gene disruption (Knockouts):** knocking out the gene, and looking for possible mutant phenotypes that may provide a clue about the function(s) of the protein encoded.
- **Genome size:** the length of DNA associated with one haploid complement of chromosomes
- **Gene number:** the number of genes in a genome
- **Gene density:** the average number of genes per Mb of genomic DNA

Lecture11 techniques

- **Blunt ends and Sticky ends**
- **Plasmid:** A plasmid is a small (most of them are circular) DNA molecule that is separate from chromosomal DNA within a cell, and can replicate independently.
- **Vector:** artificial plasmid.