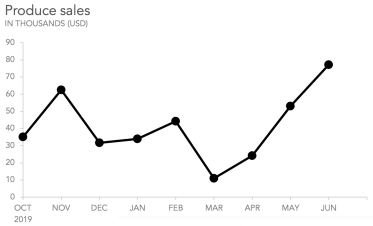
APBIO Fall Semester Final Review

- Carbohydrates Properties（碳水化合物的特性）
  - Solubility（溶解性）: Simple carbohydrates (e.g., glucose, fructose) are water-soluble due to their polar -OH groups, while complex carbohydrates like starch are less soluble.
    简单碳水化合物（如葡萄糖、果糖）因其极性的羟基（-OH）而易溶于水，而淀粉等复杂碳水化合物溶解度较低.
  - Taste（味道）: Simple sugars are sweet, while complex carbohydrates (e.g., starch) are tasteless.
    简单糖类有甜味，而复杂碳水化合物（如淀粉）无味.
  - Structure（结构）: Carbohydrates contain carbon (C), hydrogen (H), and oxygen (O) in a ratio of 1:2:1 (e.g., C6H12O6 for glucose).
    碳水化合物由碳（C）、氢（H）和氧（O）组成，比例为1:2:1（例如葡萄糖的分子式C6H12O6）.
  - Energy Source（能量来源）: They are the primary energy source for living organisms, releasing energy during cellular respiration.
    它们是生物体的主要能量来源，在细胞呼吸过程中释放能量.
  - Reducing Nature（还原性）: Monosaccharides and some disaccharides (e.g., glucose, lactose) are reducing sugars and can react with Benedict's solution.
    单糖和某些二糖（如葡萄糖、乳糖）具有还原性，可以与本尼迪克试剂发生反应.
  - Polymer Formation（聚合物形成）: Carbohydrates form polysaccharides (e.g., cellulose, glycogen) through glycosidic bonds.
    碳水化合物通过糖苷键形成多糖（如纤维素、糖原）.
  - Optical Activity（旋光性）: Many carbohydrates exhibit optical isomerism, rotating plane-polarized light.
    许多碳水化合物具有旋光性，可以使平面偏振光发生旋转.
  - Hydrolysis（水解性）: Disaccharides and polysaccharides can be broken down into monosaccharides with acids or enzymes.
    二糖和多糖可以在酸或酶的作用下水解为单糖.
  - Hygroscopic Nature（吸湿性）: Some carbohydrates (e.g., sugar) attract and hold water molecules.
    一些碳水化合物（如糖）具有吸湿性，能吸附并保持水分.
- Water Properties（水的特性）
  - Polarity（极性）: Water is a polar molecule with partial positive charges on hydrogen and a partial negative charge on oxygen, allowing it to form hydrogen bonds.
    水分子具有极性，氢原子带部分正电荷，氧原子带部分负电荷，这使水能够形成氢键.
  - Universal Solvent（通用溶剂）: Water dissolves many substances, especially polar and ionic compounds, making it essential for life.
    水可以溶解许多物质，特别是极性物质和离子化合物，因此是生命必需的溶剂.
  - High Specific Heat Capacity（高比热容）: Water absorbs and retains heat, which helps regulate temperature in organisms and the environment.
    水具有高比热容，能吸收并保持热量，有助于调节生物体和环境的温度.
  - Cohesion and Adhesion（内聚力和附着力）: Water molecules stick to each other (cohesion) and to other surfaces (adhesion), which allows capillary action in plants.
    水分子之间具有内聚力，同时也能附着在其他表面上（附着力），这使植物中的毛细现象成为可能.
  - High Surface Tension（高表面张力）: Water has a high surface tension due to hydrogen bonding, allowing small organisms to move on its surface.
    由于氢键的存在，水具有高表面张力，使一些小生物能够在水面上行走.

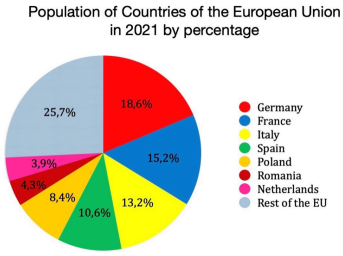
- Neutral pH（中性酸碱性）: Pure water has a pH of 7, meaning it is neither acidic nor basic.
  纯水的pH值为7，既不酸也不碱.

- Proper Graph Type（适当的图表类型）
  - Bar Chart (柱状图)
    Use for: Comparing categories or groups.
    Example: Sales of different products in a month.
    Key Feature: Easy to compare quantities.
    用于比较不同类别或组的数量差异，例如一个月内不同产品的销售额.

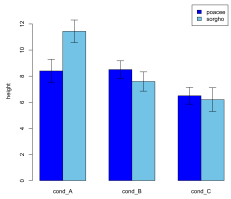
  - Line Graph (折线图)
    Use for: Showing trends or changes over time.
    Example: Stock prices over the past 6 months.
    Key Feature: Shows progression or trends.
    用于显示随时间变化的趋势，例如过去 6 个月的股票价格变化.



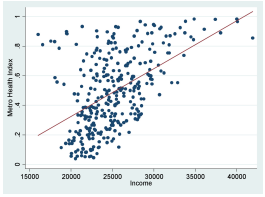
  - Pie Chart (饼图)
    Use for: Showing proportions or percentages.
    Example: Market share of companies in an industry.
    Key Feature: Best for showing part-to-whole relationships.
    用于显示各部分与整体的关系，例如行业内公司市场份额的占比.



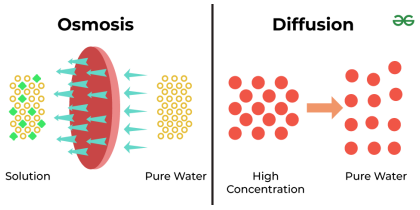
  - Histogram (直方图)
    Use for: Displaying frequency distributions.
    Example: Test scores of students in a class.
    Key Feature: Similar to bar charts but for continuous data.
    用于显示频率分布，例如班级中学生的考试分数. 与柱状图相似，但用于连续数据.



  - Scatter Plot (散点图)
    Use for: Showing relationships or correlations between two variables.
    Example: Relationship between height and weight of students.
    Key Feature: Reveals patterns, clusters, and outliers.
    用于显示两个变量之间的关系，例如学生的身高与体重的关系.
    可以揭示模式、聚类和异常值.



- Interpret graph（解释图表）
- Osmosis/Diffusion Lab Data Interpretation（渗透/扩散实验室数据解释）
  - Osmosis: If water moves into the object, the mass increases (hypotonic solution). If water moves out, the mass decreases (hypertonic solution).
    渗透作用：如果水分进入物体，质量增加（低渗溶液）.
    如果水分流出物体，质量减少（高渗溶液）.

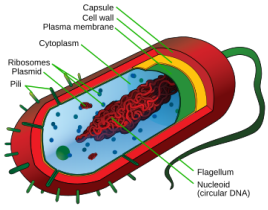


  - Diffusion: Solutes move from high concentration to low concentration until equilibrium is reached.
    扩散：溶质会从高浓度区域扩散到低浓度区域，直到达到平衡.
  - Hypotonic Solution (低渗溶液): Water enters the object; mass increases.
    低渗溶液：水分进入细胞，质量增加.
  - Hypertonic Solution (高渗溶液): Water leaves the object; mass decreases.
    高渗溶液：水分离开细胞，质量减少.
  - Isotonic Solution (等渗溶液): No significant mass change.
    等渗溶液：细胞内外水分平衡，质量无明显变化.
- Internal Membrane Function（细胞内膜的功能）

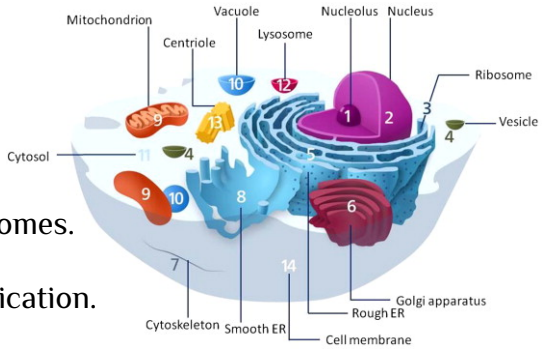
- Compartmentalization（分隔功能）: Internal membranes divide the cell into distinct compartments, allowing different cellular processes to occur simultaneously without interference.
  细胞内膜将细胞分成不同的区域，使不同细胞过程可以在不相互干扰情况下同时进行.
  Example: Membranes surround organelles like the nucleus, mitochondria, and lysosomes
  例子：内膜包围细胞核、线粒体和溶酶体等细胞器.
- Surface for Reactions（反应表面）: Internal membranes provide surfaces for essential biochemical reactions, such as cellular respiration and photosynthesis.
  内膜为重要的生化反应提供表面，比如细胞呼吸和光合作用.
  Example: The inner membrane of the mitochondria contains enzymes for ATP production.
  例子：线粒体的内膜含有ATP合成所需的酶.
- Transport of Substances（物质运输）: Internal membranes regulate the transport of molecules in and out of organelles, maintaining specific environments.
  内膜调节分子进出细胞器，维持特定的环境.
  Example: The endoplasmic reticulum (ER) transports proteins and lipids.
  例子：内质网（ER）负责蛋白质和脂质的运输.
- Energy Transformation（能量转换）: Internal membranes are critical for energy conversion processes.
  内膜对于能量转换过程至关重要.
  Example: Chloroplast thylakoid membranes carry out photosynthesis.
  例子：叶绿体类囊体膜执行光合作用.
- Molecular Synthesis（分子合成）: Internal membranes participate in the synthesis of proteins, lipids, and other macromolecules.
  内膜参与蛋白质、脂质和其他大分子的合成.
  Example: The rough endoplasmic reticulum is involved in protein synthesis.
  例子：粗面内质网参与蛋白质合成.
- Cell Signaling（细胞信号传递）: Internal membranes can help in signal transduction, enabling communication within the cell.
  内膜在信号传递中起作用，帮助细胞内部进行交流.
  Example: Membranes contain receptors that respond to signals like hormones.
  例子：内膜含有受体，可以对激素等信号作出反应.

- Graph Independent/Dependent Variable（画自变/因变量）
  - Independent Variable（自变量）: Always on the x-axis (horizontal).
    自变量：始终位于x轴（水平轴）.
  - Dependent Variable（因变量）: Always on the y-axis (vertical).
    因变量：始终位于y轴（垂直轴）.
- Membrane Function/Potential（膜的功能与膜电位）
  - Selective Permeability（选择透过性）: The membrane controls what enters and exits the cell, allowing nutrients, water, and ions to move while keeping harmful substances out.
    膜控制物质进出细胞，允许营养物质、水和离子通过，同时阻止有害物质进入.
  - Cell Communication（细胞通信）: Membranes contain proteins and receptors that allow cells to respond to signals (e.g., hormones).
    细胞膜上含有蛋白质和受体，帮助细胞接收和响应信号（如激素）.
  - Transport of Molecules（物质运输）:
  - Passive Transport（被动运输）: Molecules move from high to low concentration (diffusion, osmosis).
    被动运输：物质从高浓度向低浓度移动（扩散、渗透）.
  - Active Transport（主动运输）: Requires energy (ATP) to move molecules against the concentration gradient.
    主动运输：需要能量（ATP）将物质逆浓度梯度运输.

    - Membrane Potential（膜电位）: Membrane potential is the electrical potential difference across the membrane due to the unequal distribution of ions (e.g., Na^+, K^+, Cl^-).
      膜电位是由于离子（如Na^+、K^+、Cl^-）分布不均而导致的膜两侧的电位差.
    - Resting Potential（静息电位）: In resting cells, the inside of the cell is negative relative to the outside due to ion gradients maintained by ion pumps (e.g., sodium-potassium pump).
      静息细胞内的电位比细胞外更负，这是由离子梯度和离子泵（如钠钾泵）维持的.
    - Action Potential（动作电位）: When stimulated, ion channels open, causing a rapid change in membrane potential (e.g., in neurons).
      当受到刺激时，离子通道打开，膜电位快速变化（如神经元中的动作电位）.
- Phospholipid Structure（磷脂结构）
    - Phospholipid Structure（磷脂结构）: Phospholipids are the main component of the cell membrane. Each phospholipid molecule has:
      磷脂是细胞膜的主要成分，每个磷脂分子具有：
    - Hydrophilic Head（水亲头）: Made of a phosphate group and glycerol, it attracts water.
      亲水头：由磷酸基团和甘油组成，吸引水分子.
    - Hydrophobic Tails（疏水尾）: Made of two fatty acid chains, it repels water.
      疏水尾：由两条脂肪酸链组成，排斥水分子.
    - Phospholipid Bilayer（磷脂双分子层）: In water, phospholipids form a bilayer with hydrophobic tails facing inward and hydrophilic heads facing outward, creating a barrier that separates the internal and external environments of the cell.
      在水中，磷脂分子形成双分子层，疏水尾朝内，亲水头朝外，形成一个隔离细胞内外环境的屏障.
- Calculation（计算）
- SA/V Ratio（表面积与体积比）
    - SA/V = Volume/Surface Area
    - Higher SA/V ratio = Faster exchange of materials = More efficient cells.
      SA/V比高 = 物质交换更快 = 细胞效率更高.
    - Lower SA/V ratio = Slower material exchange = Limits cell size.
      SA/V比低 = 物质交换变慢 = 细胞大小受限.
- Osmosis/Diffusion Lab Data Interpretation（渗透/扩散实验数据分析）
    - Mass Increase: If an object (e.g., potato slice) gains mass, it was placed in a hypotonic solution (lower solute concentration outside; water enters the cell).
      质量增加：物体（如土豆片）在低渗溶液中，水分进入细胞.
    - Mass Decrease: If an object loses mass, it was placed in a hypertonic solution (higher solute concentration outside; water leaves the cell).
      质量减少：物体在高渗溶液中，水分离开细胞.
    - No Change: If no mass change occurs, the solution is isotonic (equal solute concentration).
      质量无变化：溶液是等渗的，溶质浓度相等.
    - Osmotic Pressure（渗透压）: Osmotic pressure is the pressure exerted by water movement across a membrane due to differences in solute concentration.
      渗透压是由溶质浓度差导致水分跨膜移动所产生的压力.
- Prokaryote Structure（原核细胞结构）
    - Basic Features（基本特征）: No nucleus; DNA is in the nucleoid region. Lacks membrane-bound organelles. Has a cell wall for protection.
      没有细胞核，DNA位于拟核区域；缺少膜包围的细胞器；具有细胞壁.
    - Plasma Membrane（细胞膜）: Controls transport.
      控制物质运输.
    - Cytoplasm（细胞质）: Fluid containing molecules and ribosomes.
      含有分子和核糖体的液体.



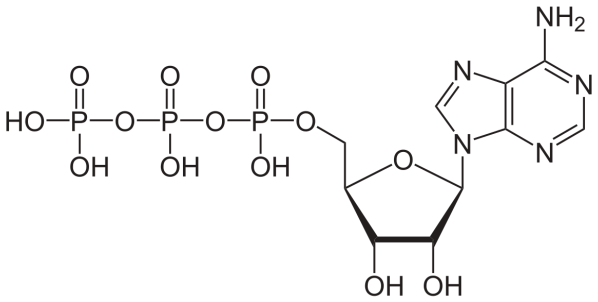
- Ribosomes（核糖体）: Protein synthesis.
  进行蛋白质合成.
- Flagella/Pili（鞭毛/菌毛）: Movement and attachment.
  帮助运动和附着.



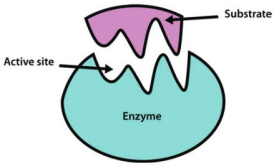
- Endomembrane System（内膜系统）
  - Nuclear Envelope（核膜）: Protects the nucleus.
    保护细胞核.
  - Rough ER（粗面内质网）: Protein synthesis with ribosomes.
    含核糖体，进行蛋白质合成.
  - Smooth ER（滑面内质网）: Lipid synthesis and detoxification.
    合成脂质并解毒.
  - Golgi Apparatus（高尔基体）: Modifies, packages, and ships proteins and lipids.
    修饰、打包和运输蛋白质及脂质.
  - Lysosomes（溶酶体）: Breaks down waste.
    分解废物.
  - Vesicles（囊泡）: Transport substances.
    运输物质.
- Transmembrane Protein Structure（跨膜蛋白结构）
  - Hydrophilic Regions（亲水区域）: Interact with water outside and inside the cell.
    与细胞内外的水分相互作用.
  - Hydrophobic Regions（疏水区域）: Embedded within the phospholipid bilayer.
    嵌入磷脂双分子层内.
  - Transport Proteins（运输蛋白）: Move ions and molecules.
    运输蛋白：运输离子和分子.
  - Receptor Proteins（受体蛋白）: Signal recognition.
    受体蛋白：识别信号分子.
- Photosynthesis Graph（光合作用图表）
  - Light Intensity vs. Rate of Photosynthesis（光照强度与光合作用速率）: As light intensity increases, the photosynthesis rate increases until it plateaus (reaches a maximum).
    光照强度增加时，光合作用速率增加，直到达到最大值（平台期）.
  - CO_2 Concentration vs. Photosynthesis（CO_2浓度与光合作用）: Higher CO_2 concentration increases the photosynthesis rate until saturation.
    更高的CO_2浓度会增加光合作用速率，直到饱和点.
  - Temperature vs. Photosynthesis（温度与光合作用）: Photosynthesis rate increases with temperature up to an optimum point; beyond this, enzymes denature, and the rate decreases.
    光合作用速率随着温度上升，在最佳温度达到最大值，超此温度酶变性导致速率下降.
- ATP Synthase（ATP合成酶）
  - ATP Synthase is an enzyme found in the mitochondria and chloroplasts that synthesizes ATP from ADP and inorganic phosphate (Pi) using the energy from a proton gradient across the membrane. It functions during oxidative phosphorylation in mitochondria (cellular respiration) and photophosphorylation in chloroplasts (photosynthesis).
    ATP合成酶存在于线粒体和叶绿体中，通过利用跨膜质子梯度的能量将ADP和无机磷酸（Pi）合成ATP. 它在线粒体的氧化磷酸化和叶绿体的光磷酸化过程中发挥作用.
- Respiration Data Interpretation（呼吸实验数据分析）
  - Oxygen Consumption and Carbon Dioxide Production (氧气消耗与二氧化碳产生): Higher oxygen consumption and higher CO_2 production indicate a higher rate of cellular respiration. The respiration rate increases with temperature, up to an optimal point, after which it declines as enzymes become denatured.

较高的氧气消耗和较高的二氧化碳产生表明细胞呼吸速率较高. 随着温度升高，呼吸速率增加，直到达到最佳温度，之后由于酶变性，速率会下降.

- Photosynthesis Data（光合作用数据）
- Competitive Inhibitor Function（竞争性抑制剂的功能）
    - Competitive inhibitors bind to the active site of an enzyme, competing with the substrate for binding. This reduces the rate of enzyme-catalyzed reactions because fewer enzyme-substrate complexes form.
      竞争性抑制剂与底物竞争结合到酶的活性位点，从而降低酶催化反应速率，因为酶-底物复合物减少.
    - The effect of a competitive inhibitor can be overcome by increasing the concentration of the substrate.
      通过增加底物浓度可以克服竞争性抑制剂的影响.
- Enzyme Function Experimental Data（酶功能实验数据）
- Photosynthesis CO2（光合作用中的二氧化碳）
    - The Calvin cycle, also known as the dark reactions or light-independent reactions, takes place in the stroma of the chloroplast. It is the part of photosynthesis where carbon dioxide (CO_2) is fixed into organic molecules, ultimately forming glucose.
      卡尔文循环，也称为暗反应或光独立反应，发生在叶绿体的基质中，是光合作用的一部分，其中二氧化碳（CO_2）被固定到有机分子中，最终形成葡萄糖.
- ATP （三磷酸腺苷）
    - ATP is the primary energy carrier in cells. It consists of adenine, ribose, and three phosphate groups. Energy is released when the bond between the second and third phosphate groups is broken, converting ATP into ADP (adenosine diphosphate).
      ATP是细胞中的主要能量载体，包含腺嘌呤、核糖和三个磷酸基团. 当第二个和第三个磷酸基团之间的键断裂时，ATP转化为ADP，释放能量.

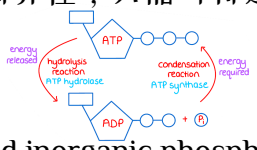


    - ATP is used in cellular processes such as active transport, muscle contraction, and protein synthesis.
      ATP用于细胞过程，如主动运输、肌肉收缩和蛋白质合成.
- Photosynthesis/Respiration Energy（光合作用/呼吸作用能量）
    - Photosynthesis (光合作用): Converts light energy into chemical energy stored in glucose. It occurs in the chloroplasts, where light reactions generate ATP and NADPH, and the Calvin cycle uses these to fix CO_2 into organic molecules.
      将光能转化为化学能储存在葡萄糖中，发生在叶绿体内，光反应生成ATP和NADPH，卡尔文循环利用这些能量将二氧化碳固定成有机分子.
    - Respiration (呼吸作用): Breaks down glucose into ATP through processes like glycolysis, the citric acid cycle, and oxidative phosphorylation in the mitochondria. ATP is used as energy by the cell.
      通过如糖酵解、柠檬酸循环和氧化磷酸化等过程分解葡萄糖产生ATP，ATP为细胞提供能量.

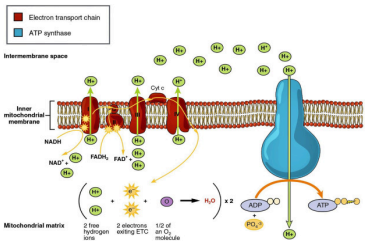


- Chemiosmosis（化学渗透）
- Enzyme Function Graphs（酶功能图）
- Enzyme Specificity（酶的特异性）
    - Enzymes are highly specific to their substrates due to the unique shape of their active site, which fits only specific substrate molecules. This specificity allows enzymes to catalyze only certain reactions.

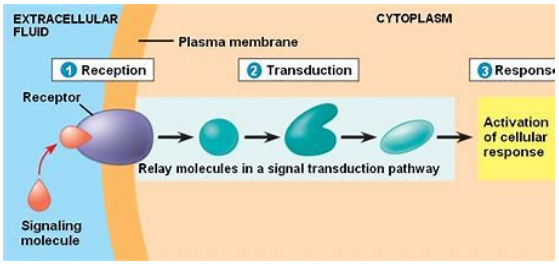
酶由于其活性位点的独特形状，对底物具有高度特异性，只能与特定的底物分子结合，这种特异性使得酶只能催化某些反应.



- Enzyme Denaturation（酶变性）
- ATP Hydrolysis（ATP水解）
  - ATP hydrolysis is the breakdown of ATP into ADP and inorganic phosphate (Pi) by the addition of water, releasing energy used by the cell for various activities.
    通过加水将ATP分解为ADP和无机磷酸（Pi），释放细胞用于各种活动的能量.
- Metabolism and Oxygen Consumption（代谢与氧气消耗）
  - Metabolism (代谢): Refers to all chemical reactions that occur within a cell to maintain life, including both catabolic (energy-releasing) and anabolic (energy-consuming) processes.
    细胞内维持生命的所有化学反应，包括分解代谢（释放能量）和合成代谢（消耗能量）过程.
  - Oxygen Consumption (氧气消耗): Oxygen is consumed during aerobic respiration as it is the final electron acceptor in the electron transport chain, leading to ATP production.
    有氧呼吸过程中，氧气作为电子传递链中的最终电子受体，被消耗，导致ATP的生成.
- Light Reactions（光反应）
  - The light reactions of photosynthesis occur in the thylakoid membranes of chloroplasts, where light energy is captured by chlorophyll and used to produce ATP and NADPH, which are used in the Calvin cycle.
    光合作用的光反应发生在叶绿体的类囊体膜上，光能被叶绿素吸收并用于生成ATP和NADPH，这些能量分子在卡尔文循环中使用.
- Enzyme Optimal Conditions（酶的最佳条件）
- Negative Feedback（负反馈）
  - Negative feedback is a regulatory mechanism in which a change in a system triggers a response that counteracts the initial change, maintaining balance or homeostasis.
    一种调节机制，系统中的变化触发反应，反作用于初始变化，从而维持平衡或稳态.
- Electron Transport Chain/ATP Synthesis（电子传递链/ATP合成）
  - The electron transport chain (ETC) is a series of proteins embedded in the inner mitochondrial membrane (or thylakoid membrane in chloroplasts) that pass electrons, ultimately producing a proton gradient that drives ATP synthesis via chemiosmosis.
    一系列嵌入线粒体内膜（或叶绿体类囊体膜）的蛋白质，通过传递电子，最终产生质子梯度，通过化学渗透驱动ATP合成.



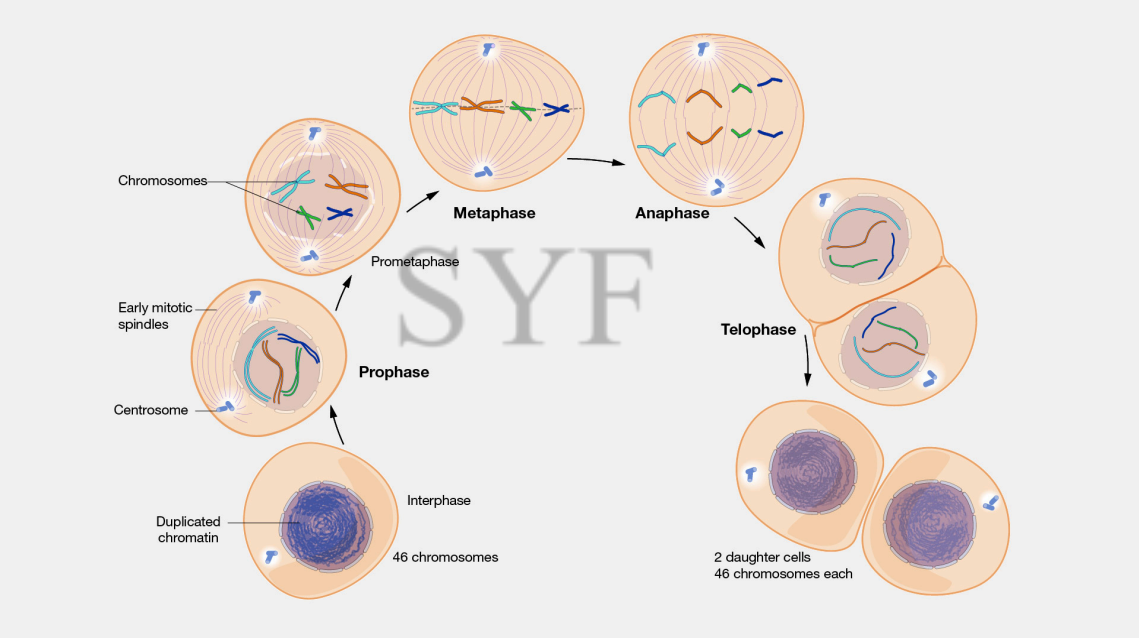
- Oxygen Consumption Graph（氧气消耗图）
- Factors Affecting Enzyme Reaction Rate（影响酶反应速率的因素）
  - Substrate Concentration (底物浓度): As the concentration of substrate increases, the reaction rate increases until the enzyme becomes saturated.
    随着底物浓度的增加，反应速率增加，直到酶达到饱和.
  - Temperature and pH (温度和pH): Deviations from the optimal temperature and pH reduce enzyme activity.
    偏离最佳温度和pH会减少酶的活性.
- Experimental Data-Respiration Rate（实验数据 - 呼吸速率）
- Signal Transduction（信号传导）
  - Reception (接收): A signal molecule (ligand) binds to a receptor on the cell surface or inside the cell.
    信号分子（配体）与细胞表面或细胞内的受体结合.
  - Transduction (传导): The receptor undergoes a conformational change, activating intracellular



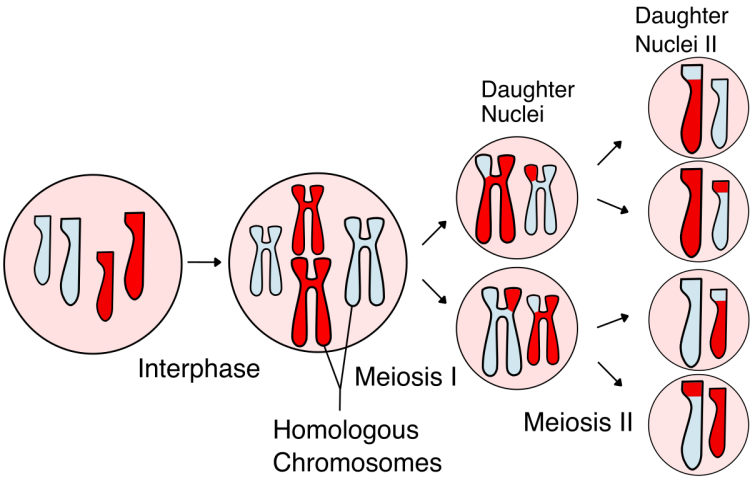
signaling pathways, often involving second messengers (like cAMP, calcium ions).
受体发生构象变化，激活细胞内的信号传导途径，通常涉及第二信使（如cAMP、钙离子等）.

- Response (反应): The signal transduction pathways lead to a cellular response, such as changes in gene expression, cell division, or metabolic activity.
  信号转导途径导致细胞反应，例如基因表达变化、细胞分裂或代谢活动改变.

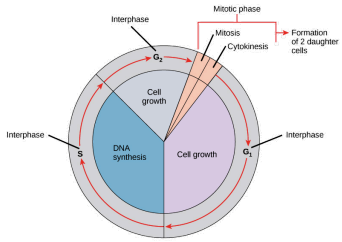
- Feedback Inhibition（反馈抑制）
  - Feedback Inhibition (反馈抑制): Feedback inhibition is a regulatory mechanism in which the product of a process inhibits an earlier step in the process to prevent the overproduction of the product. This helps maintain homeostasis.
    一种调节机制，其中一个过程的产物抑制该过程的早期步骤，以防止产物的过度生产. 这有助于维持稳态.
- Mitosis vs. Meiosis（有丝分裂 vs. 减数分裂）
  - Mitosis (有丝分裂): Results in two genetically identical daughter cells, used for growth, repair, and asexual reproduction.
    产生两个基因完全相同的子细胞，用于生长、修复和无性繁殖.



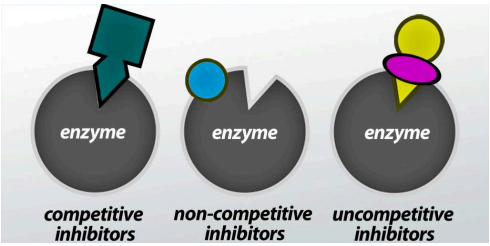
  - Meiosis (减数分裂): Results in four genetically diverse daughter cells, used for sexual reproduction.
    产生四个基因多样的子细胞，用于有性繁殖.



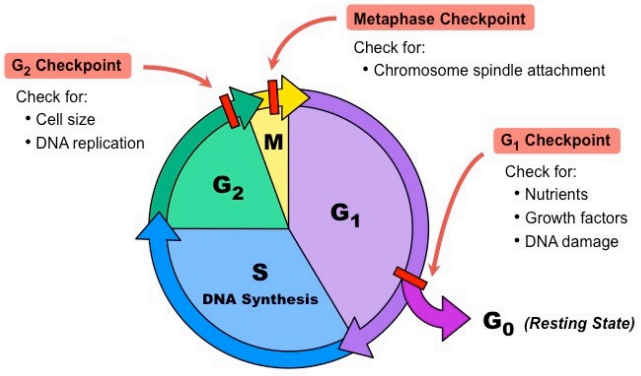
- Cell Cycle DNA Graph（细胞周期DNA图）
  - A graph of DNA content in a cell cycle shows phases such as G1, S, G2, and M. The DNA content doubles during the S phase as DNA is replicated, and then the cell divides in mitosis.
    细胞周期DNA图显示G1、S、G2和M等阶段。在S期，DNA含量加倍，因为DNA被复制，随后细胞在有丝分裂中分裂。



- Glucose Regulation Graph（葡萄糖调节图）
- Chromosome Number Changes in Mitosis（有丝分裂中的染色体数目变）
  - During mitosis, the chromosome number remains the same. Each daughter cell receives an exact copy of the chromosomes from the parent cell.
    有丝分裂过程中，染色体数目保持不变。每个子细胞从母细胞接收一份相同的染色体。
- Positive Feedback（正反馈）
  - Positive feedback amplifies the initial stimulus, leading to an enhanced response. An example is the process of childbirth, where oxytocin stimulates contractions, which in turn stimulate more oxytocin release.
    正反馈增强初始刺激，从而产生更强的反应。例如分娩过程中，催产素刺激子宫收缩，进而刺激更多催产素的释放。
- Active Site Mutation（活性位点突变）
- Inhibition-Figure Interpretation（抑制图解解释）
  - Inhibition can be competitive (competing with the substrate for the active site) or non-competitive (binding elsewhere on the enzyme, changing its shape). A graph might show how increasing substrate concentration can overcome competitive inhibition but not non-competitive inhibition.
    抑制可以是竞争性的（与底物竞争活性位点）或非竞争性的（结合到酶的其他位置，改变其形状）。可能显示增加底物浓度可以克服竞争性抑制，但无法克服非竞争性抑制。



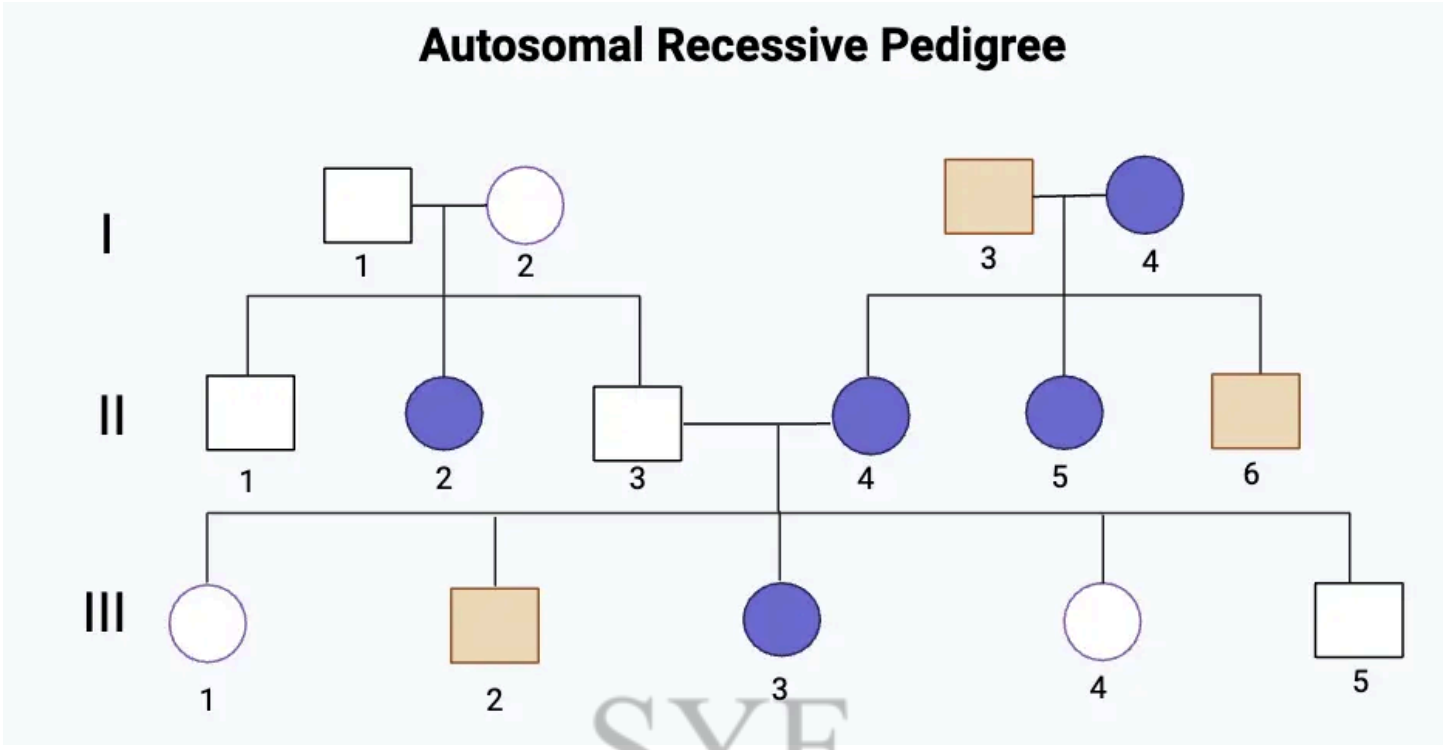
- Steroid Hormone Function（类固醇激素功能）
- Cell Cycle Regulation（细胞周期调控）
  - G1 Checkpoint (G1检查点): Determines whether the cell is ready to proceed with DNA replication. It checks for adequate size, nutrient availability, and DNA integrity.
    决定细胞是否准备好进入DNA复制阶段，检查细胞大小、营养和DNA完整性。
  - G2 Checkpoint (G2检查点): Ensures that DNA replication has been completed correctly before the cell enters mitosis.
    确保DNA复制完成后，细胞才能进入有丝分裂。



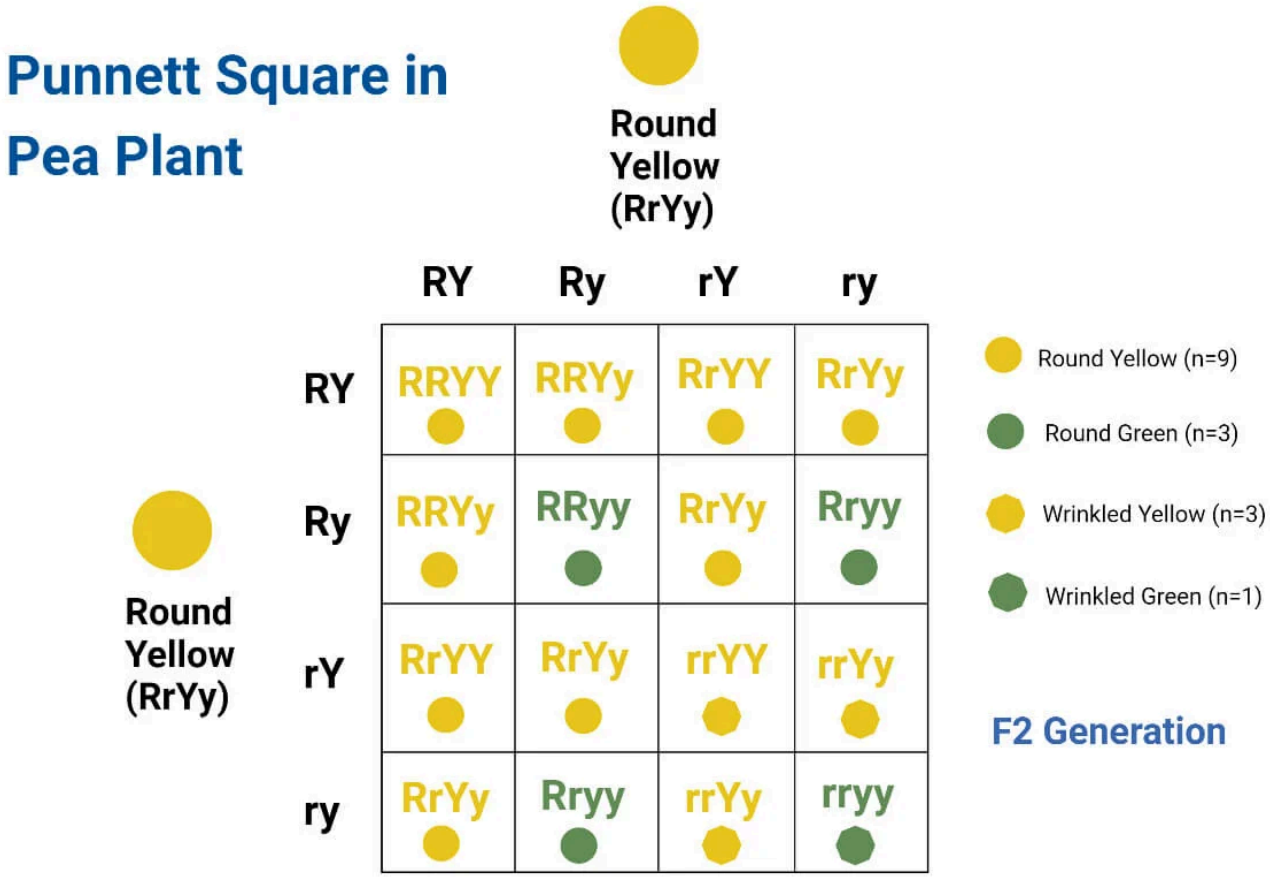
  - M Checkpoint(M检查点): Occurs during mitosis to ensure proper chromosome alignment and segregation.
    发生在有丝分裂过程中，确保染色体的排列和分离正确。
  - Cyclins (周期蛋白): Proteins that regulate the progression of the cell cycle. Their concentration varies throughout the cycle.
    调节细胞周期进程的蛋白质，浓度在周期中变化。

- Cyclin-Dependent Kinases (CDKs) (周期蛋白依赖性激酶): Enzymes activated by cyclins. Together, they phosphorylate target proteins to promote cell cycle progression.
  与周期蛋白结合后被激活，磷酸化目标蛋白，推动细胞周期的进程.

- Pedigree（家谱）



- Genetic Cross（遗传交叉）



- Meiosis Nondisjunction（减数分裂非分离）
    - Nondisjunction occurs when chromosomes fail to separate properly during meiosis, leading to gametes with an incorrect number of chromosomes. This can result in conditions like Down syndrome (trisomy 21) or Turner syndrome (monosomy X).
      非分离发生在减数分裂过程中，染色体未能正确分离时，导致配子染色体数量不正确，可能导致像唐氏综合症（三体21号染色体）或特纳综合症（单体X染色体）等遗传病.
- Linked Genes（连锁基因）
    - Linked genes are inherited together due to their proximity on the same chromosome.
      连锁基因因其位于同一染色体上且靠近而一起遗传.
    - Unlinked genes assort independently, as they are located on different chromosomes or far apart on the same chromosome.
      非连锁基因由于位于不同染色体上或同一染色体上相距较远而独立遗传.
- Genetic Cross Achondroplasia（遗传交叉-软骨发育不全）
    - Achondroplasia is a genetic disorder caused by a dominant allele. A genetic cross can be used to predict the probability of offspring inheriting the condition. If one parent is heterozygous (Aa) and the other is homozygous normal (aa), the cross would produce a 50% chance of an affected child.
      软骨发育不全是一种由显性等位基因引起的遗传疾病. 遗传交叉可以用来预测后代遗传该疾病的概率. 如果一方父母是杂合子（Aa），另一方是纯合正常基因型（aa），交叉结果会有50%的概率得到一个患病的孩子.
- Sex-Linked Traits（性联性状）
    - Sex-linked traits are traits controlled by genes located on sex chromosomes (X or Y). The most common sex-linked traits are X-linked, such as color blindness or hemophilia. These traits are often more common in males because they only have one X chromosome.
      性联性状是由性染色体（X或Y）上的基因控制的性状. 最常见的性联性状是X联性状，如色盲或血友病. 由于男性只有一个X染色体，这些性状在男性中更为常见.
- Genetic Cross - Null Hypothesis（遗传交叉 - 零假设）
    - A null hypothesis in genetic crosses is used to test if the observed genetic results differ significantly from what is expected by chance. It suggests that any observed differences are due to random variation.
      遗传交叉中的零假设用于测试观察到的遗传结果是否与随机期望结果显著不同. 它表明观察到的差异是由于随机变化所致.
- Genetic Cross - Chi-Square（遗传交叉 - 卡方检验）

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

χ^2 = the test statistic $\sum$ = the sum of

O = Observed frequencies E = Expected frequencies

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

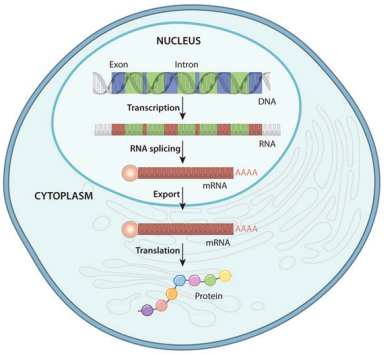
Chi-Square Distribution Table

df	Level of Significance									
	0.995	0.975	0.2	0.1	0.05	0.025	0.02	0.01	0.005	0.002	0.001
1	0.00004	0.00098	1.642	2.706	3.841	5.024	5.412	6.635	7.879	9.55	10.83
2	0.01	0.0506	3.219	4.605	5.991	7.378	7.824	9.21	10.6	12.43	13.82
3	0.0717	0.216	4.642	6.251	7.815	9.348	9.837	11.35	12.84	14.8	16.27
4	0.207	0.484	5.989	7.779	9.488	11.14	11.67	13.28	14.86	16.92	18.47
5	0.412	0.831	7.289	9.236	11.07	12.83	13.39	15.09	16.75	18.91	20.52
6	0.676	1.237	8.558	10.65	12.59	14.45	15.03	16.81	18.55	20.79	22.46
7	0.989	1.69	9.803	12.02	14.07	16.01	16.62	18.48	20.28	22.6	24.32
8	1.344	2.18	11.03	13.36	15.51	17.54	18.17	20.09	21.96	24.35	26.12
9	1.735	2.7	12.24	14.68	16.92	19.02	19.68	21.67	23.59	26.06	27.88
10	2.156	3.247	13.44	15.99	18.31	20.48	21.16	23.21	25.19	27.72	29.59
11	2.603	3.816	14.63	17.28	19.68	21.92	22.62	24.73	26.76	29.35	31.26
12	3.074	4.404	15.81	18.55	21.03	23.34	24.05	26.22	28.3	30.96	32.91
13	3.565	5.009	16.99	19.81	22.36	24.74	25.47	27.69	29.82	32.54	34.53
14	4.075	5.629	18.15	21.06	23.69	26.12	26.87	29.14	31.32	34.09	36.12
15	4.601	6.262	19.31	22.31	25	27.49	28.26	30.58	32.8	35.63	37.7
16	5.142	6.908	20.47	23.54	26.3	28.85	29.63	32	34.27	37.15	39.25
17	5.697	7.564	21.62	24.77	27.59	30.19	31	33.41	35.72	38.65	40.79
18	6.265	8.231	22.76	25.99	28.87	31.53	32.35	34.81	37.16	40.14	42.31
19	6.844	8.907	23.9	27.2	30.14	32.85	33.69	36.19	38.58	41.61	43.82
20	7.434	9.591	25.04	28.41	31.41	34.17	35.02	37.57	40	43.07	45.32

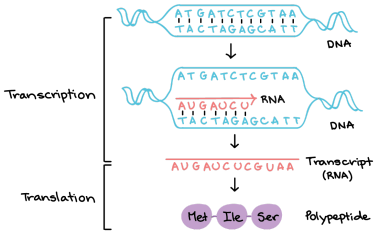
Note that for $v > 100$, percentiles of χ^2may be approximated with $\chi^2_{v[P]} = \frac{1}{2}\left(Z_{([P])} + \sqrt{2v-1}\right)^2$ utilizing the percentiles $Z_{[P]}$:

P	0.001	0.005	0.010	0.025	0.050	0.250	0.500	0.750	0.950	0.975	0.990	0.995	0.999
z	-3.090	-2.576	-2.326	-1.96	-1.645	-0.674	0.000	0.674	1.645	1.960	2.326	2.576	3.090

- Genetic Cross - Experimental Data（遗传交叉 - 实验数据）
- DNA Mutations（DNA突变）
    - Silent Mutations (沉默突变): These mutations do not change the protein produced, so they typically have no effect on the organism.
      不改变蛋白质，通常对生物体没有影响.
    - Missense Mutations (错义突变): These mutations change the amino acid sequence, which can alter the function of the resulting protein. This can lead to diseases or disorders if the protein is crucial for cellular functions.
      改变蛋白质的氨基酸序列，可能导致疾病.
    - Nonsense Mutations (无义突变): These mutations introduce a premature stop codon, resulting in a shortened protein that is often nonfunctional. This can cause severe genetic disorders.
      提前终止蛋白质的合成，导致非功能性蛋白质.
    - Frameshift Mutations (移码突变): Insertions or deletions can shift the reading frame, leading to a completely different protein being made. This often results in a nonfunctional protein and can lead to diseases like cystic fibrosis.
      改变阅读框架，通常导致非功能性蛋白质.
    - Beneficial Mutations (有益突变): Occasionally, a mutation can provide an advantage, such as increased resistance to diseases. These mutations can become more common in a population over time through natural selection.
      少数情况下，突变可能有益，如增强抗病能力.
- mRNA Processing（mRNA处理）
    - mRNA processing involves modifications that occur to the messenger RNA after transcription, including 5' capping, polyadenylation, and splicing to remove introns. This ensures the mRNA is ready for translation.
      mRNA处理是在转录后发生的修改，包括5'帽加、加多腺苷酸尾和剪接去除内含子. 这确保了mRNA为翻译做好准备.
- Interpretation of Diagram（图标解读）
- Bacterial Transformation（细菌转化）
- Gene Expression（基因表达）
    - Gene expression refers to the process by which information from a gene is used to create a functional product, typically a protein, through transcription and translation.
      基因表达是指基因中的信息通过转录和翻译过程用于产生功能性产物，通常是蛋白质.



- Transcription（转录）
    - Transcription is the process where an RNA molecule is synthesized from a DNA template. This RNA serves as the messenger that carries genetic information to the ribosomes for translation.
      转录是通过DNA模板合成RNA分子的过程. 该RNA作信使，将遗传信息传递到核糖体，进行翻译.
- Translation（翻译）
    - Translation is the process where the mRNA sequence is decoded into a specific amino acid sequence, forming a protein. This occurs in the ribosome.
    - 翻译是指mRNA序列被解码成特定的氨基酸序列，形成蛋白质的过程. 该过程发生在核糖体中.



- Positive/Negative Control（正负调控）