

THIRTY-THREE THINGS EVERY BIOLOGY STUDENT SHOULD KNOW

CHEMISTRY OF LIFE

1. When in doubt, answer **CARBON**. Carbon is the most important element of life. When you have a question about elements or molecules and you aren't sure of the answer, look for Carbon.
2. **CHNOPS**. Besides **Carbon**, 5 other elements are very important to living things, **Hydrogen, Nitrogen, Oxygen, Phosphorus** and **Sulfur**. Look for these key words in multiple choice answers.
3. **The 4 Macromolecules of Life are Carbohydrates, Lipids, Nucleic Acids and Proteins**
4. **Carbohydrates are sugars** (example: Glucose). If you see a hexagon shaped (six-sided) ring molecule, it's probably a carbohydrate. Breaking down **one molecule of Glucose gives 36 to 38 ATP molecules** (ATP = energy for the cell)
5. **Photosynthesis** makes sugar (stores energy as sugar): $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Light Energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
Cellular Respiration is the reverse (releases energy as ATP). **ALL LIVING THINGS DO CELLULAR RESPIRATION**
6. **Lipids are fats**. They have an end that loves water and an end that hates water. **Lipids are important in the cell membrane** (Phospholipid Bi-layer).
7. **The nucleic acids (DNA and RNA)** are the building blocks of living organisms. Nucleic Acids work together to help cells replicate and build proteins. Nucleic Acids consist of 1) A five-carbon sugar 2) A Phosphate group and 3) A base that has nitrogen (N) atoms.
8. **DNA (Deoxyribonucleic Acid)** is the molecule in the nucleus of the cell that **stores your genes** (all the **inherited information** about you). It has a **double-helix** shape which consist of its phosphate group, five-carbon sugar (the stable 2-deoxyribose), and four nitrogen-containing bases: adenine, thymine, cytosine, and guanine. **In base pairing**, adenine links to thymine (A-T) and cytosine links to guanine (C-G)
9. **RNA (Ribonucleic Acid)** helps carry out DNA's blueprint guidelines for the creation of **proteins** from the nucleus to the ribosome. RNA is **single-stranded**. Like DNA, RNA is composed of its phosphate group, five-carbon sugar (the less stable ribose), and four nitrogen-containing bases: adenine, uracil (not thymine), guanine, and cytosine. **In base pairing**, adenine links to uracil (A-U) and cytosine links to guanine (C-G)
10. **Proteins are made of folded amino acids**. Amino acids are used in every cell of your body to build the proteins you need to survive
11. **Enzymes are proteins that speed up or make chemical reactions happen in living things**. If a science word has "ase" or "yme" at the end, it's probably an enzyme. Heat can make an enzyme not work. **Chemical reactions** start with **reactants** and end with **products**.
12. Living things balance conditions in their bodies to stay alive (example: temperature). This balance is called **homeostasis**. When a condition changes too much a **feedback loop** stops it.

CELLS

13. All living things are made up of **cells**. Animals can be **multicellular** (many cells together) or **unicellular** (one cell).
14. **Organelles** make up **cells**, which make up **tissues**, which make up **organs**, which make up **organ systems**, which make up **organisms**.
 - The **nucleus** is the control center of the cell because it contains **DNA** that codes for **proteins** that carry out the functions of the cell. Bacteria cell have no nucleus.
 - **Mitochondria** in the cell store energy.
 - All cells have a **cell membrane** that separates them from their environment.
 - Plant cells have **chloroplasts** that carry out **photosynthesis** and **cell walls** around their cell membrane that give them a rigid structure.
15. Organisms are classified into six **kingdoms**: **Archaeobacteria** (ancient bacteria), **bacteria**, **Protista** (protists; mostly single celled organisms that are either heterotrophs or autotrophs), **fungi** (fungus; multicellular, decomposer organisms), **plantae** (plants), and **animalia** (animals)
16. **Prokaryote cells have no nucleus**. "PRO means NO nucleus". **Prokaryotes are the Archaeobacteria and Eubacteria**. Only **eukaryotes have nuclei** "Eu carry a nucleus" and other organelles with membranes. **Eukaryotes are the Protista, Fungi, Plantae and Animalia**.
17. **Cellular transport** allow the cell to maintain homeostasis by maintaining an equilibrium of substances moving in and out of the cell membrane. **Passive transport** moves molecules WITH the concentration gradient (high to low) and doesn't require energy (ATP), while active transport moves molecules AGAINST the concentration gradient (Low to High) and does require energy.
18. **PMAT** - The order of the four phases of chromosome separation in cell division (**mitosis**): Prophase, Metaphase, Anaphase, Telophase
19. **Mitosis is for growth, meiosis makes gametes** (sex cells). Mitosis is simpler than meiosis.
20. **Viruses are non-living** things that attack living cells and use the cell's DNA and/or "machinery" to reproduce themselves.

EVOLUTION

21. **Evolution** is the change in organisms that occurs through generations over time.

- **Adaptations** are inherited traits that are beneficial to an organism's environment.

22. **FAME** summarizes the evidence that evolution has occurred that can be traced to **common ancestral lineage**

F- fossil evidence (remains of ancient organisms)

A – anatomical structures (body parts including **homologous**, **vestigial** and **analogous** structures)

M- molecular evidence (DNA, RNA and proteins)

E- embryological (embryos look similar from one species to the next)

Natural selection is a theory that states that those organisms' best adapted to their environment have a better chance of surviving and reproducing. "Survival of the Fittest"

GENETICS

23. **Asexual Reproduction** = one parent, a cloned copy, many offspring that develop quickly

Sexual Reproduction = two parents, variation of parents, few offspring that develop slowly

24. **Heredity** is the passage of physical or behavioral traits from one **generation** to the next.

- Traits are coded in DNA as **genes** and stored on **chromosomes**.
- Different versions of the same genes are called **alleles**.
- **Dominant** alleles are always expressed over **recessive** alleles.

25. **Genotype** is what the genes say, the answer will be letters (example: Bb), **phenotype** is what you see, the answer will be **descriptive** (example: brown eyes)

26. **Homozygous** means the **same** (GG or gg), **heterozygous** means **different** (Gg), **Dominant** (GG or Gg) **always wins over recessive** (gg). A **Punnett square** is an easy way to show genotypes and phenotypes of parents and offspring

27. **Humans have 46 (23 pairs of) chromosomes**, 23 from their mother, and 23 from their father. 22 pairs are called **autosomes**, 1 pair are **sex chromosomes (X and Y)**

28. **Dominant alleles** always win over **recessive** BUT, **incomplete dominance** mixes the traits, **co-dominance** shows both traits separately, **polygenic traits** are controlled by more than one gene, **sex-linked traits** are controlled by the X chromosome, **multiple alleles** means there are more than two possible choices, like brown, green and blue eyes, but each person still only gets two (one from Mom and one from Dad).

29. **Replication** is the copying of DNA, **Transcription** is mRNA copied from DNA, **Translation** is the decoding of mRNA by tRNA to collect amino acids to make proteins (**Protein Synthesis**)

ECOLOGY

30. Living things eat to get energy. A **food web shows what eats what to get energy**. Only a little bit of energy flows from one level to the next (about 10%)

31. Organisms can be organized into **food chains**, **food webs**, or **food pyramids**.

- **Producers** are organisms that use sunlight to make their own food (plants). **Consumers** are organisms that eat other organisms for food.
- **Herbivores** eat only producers, **carnivores** eat only other consumers, and **omnivores** can eat both producers and consumers.
- **Decomposers** eat dead organisms.

32. **Symbiosis** is a relationship between two or more living things. **Mutualism** - good for both; **commensalism** good for one and the other is unaffected; **parasitism** - good for one (parasite), bad for the other (host), **competition** - bad for both, forces struggle for survival.

ANATOMY & PHYSIOLOGY

33. The **digestive system** (mouth, pharynx, esophagus, stomach, small and large intestines, rectum) converts food into smaller molecules that can be used by cells; the **circulatory system** (heart, arteries, veins, capillaries, blood) transports nutrients and oxygen to cells and removes cell wastes; the **respiratory system** (nose, pharynx, larynx, trachea, bronchi, bronchioles, lungs) swaps oxygen and carbon dioxide; the **nervous system** (brain, spinal cord, peripheral nerves, neurons) receives and sends messages; the **muscular/skeletal system** (skeletal, smooth and cardiac muscle, bones, cartilage, ligaments, tendons) supports, protects and allows for voluntary and involuntary movement; and the **immune system** which is made up of a network of cells (white blood cells), tissues, and organs that work together to protect the body.