

Welcome AP Biology students!

In preparation for the coming year you have the following assignments to complete for the first day of class:

- AP Biology Graphing and Data Assignment
- AP Biology Textbook Assignment (Chapter 1, 2 and 3)
  - 2 References for each of the 4 “Big Ideas”
- AP Biology **OPTIONAL** Summer Reading Assignment

See each specific assignment for details.

Good luck!

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"Nothing in biology makes sense except in the light of evolution."

-- Theodosius Dobzhansky

"Industrial opportunities are going to stem more from the biological sciences than from chemistry and physics. I see biology as being the greatest area of scientific breakthroughs in the next generation."

-- George E. Brown, Jr.

"If this book has a lesson, it is that we are awfully lucky to be here--and by 'we' I mean every living thing. To attain any kind of life in this universe of ours appears to be quite an achievement. As humans we are doubly lucky, of course: We enjoy not only the privilege of existence but also the singular ability to appreciate it and even, in a multitude of ways, to make it better. It is a talent we have only barely begun to grasp."

-- Bill Bryson, A Short History of Nearly Everything

"Love: Before I heard the doctors tell  
the dangers of a kiss;  
I had considered kissing you  
The nearest thing to bliss.

But now I know biology  
And sit and sigh and moan;  
Six million mad bacteria  
and I thought we were alone!"

--Anonymous

# AP BIOLOGY TEXTBOOK ASSIGNMENT: CHEMISTRY OF LIFE

## NOTES

- *READ CHAPTERS 1, 2 and 3 in your textbook. These chapters will go into greater depth than the notes provided below.*
- *The notes below should be familiar to you from previous biology coursework. If any of it is not or you are out practice, watch the videos and reference your textbook.*
- *You will be responsible for this information and will be tested on it in the first week of class. You must **pass** this test to show your preparedness and dedication to taking AP Biology this year, as we will spend little time reviewing this information, before starting Chapter 4 during the first week of class.*
- *No book questions will be required to be completed, but if you want good questions to use as review, all of the "Do you understand concept x?" at the end of every section in your book would be good to be familiar with.*
- ***On a piece of paper write down the 4 "Big Ideas" we will use to tie all aspects of AP Biology together. For each "big idea," make two references from the readings in Chapters 1-3 that help to illustrate those "big ideas."***
  - **Big Idea 1:** The process of evolution drives the diversity and unity of life.
  - **Big Idea 2:** Living systems use free energy and molecular building blocks to grow, reproduce and maintain homeostasis.
  - **Big Idea 3:** Organisms store, retrieve and transmit information
  - **Big Idea 4:** Living systems interact with each other, resulting in emergent properties
  - **HINT:** Use the very first page of your textbook if you need help.

### **1. Nature of Mater**

- a. Matter: anything that occupies space. Ex: Desk, Human, Air, ect.
- b. Atom: Smallest part of matter. It **can not** be broken down into smaller pieces. Composed of 3 particles: Protons (+), Electrons (-), and Neutrons (n)
- c. Element: Substance that is only made of one kind of atom. Ex: Hydrogen, Oxygen, etc.
  - i. C, H, N, O, P, S
- d. Compound: Two of more different atoms or elements joined together. Ex: Salt =
- e. Covalent Bond: Two or more atoms sharing electrons to form a molecule. Covalent bonds make molecules, ex: Water, Carbon Dioxide, and Oxygen Gas

- f. Hydrogen Bond: A weak chemical attraction between **polar** molecules. Ex: Two water molecules
- g. Ionic Bond: Gain or Loss of electrons that create a molecule
- h. Ion: An atom that has gained (-) electrons or (loss) electrons (+)

Watch the following video on covalent vs. ionic bonding:

<https://www.youtube.com/watch?v=7DjsD7Hcd9U>

## 2. Water and Solutions

- a. How does water help maintain homeostasis?
  - i. Heats slowly
  - ii. Retains heat
  - iii. Carries Heat away through water vapor (sweating)
  - iv. Universal solvent (anything except for a polar substance can dissolve in it)
- b. What is the difference between adhesion & cohesion?
  - i. Adhesion: different substances
  - ii. Cohesion: alike substances
- c. What is the pH range for an Acid? Base?
  - i. Acid = 0 – 6.9
  - ii. Neutral = 7
  - iii. Base = 7.1 – 14
- d. What type of substance is an example of an acid? Of a base?
  - i. Acids: Lemon, Vinegar, Milk
  - ii. Bases: Household cleaning material

Watch the following video: <http://www.bozemanscience.com/water-a-polar-molecule/>

## 3. Chemistry of Cells

- a. Carbohydrates: Organic substances, made up of carbon, hydrogen and oxygen atoms. Always in the ratio of 1:2:1. Key source of energy.
  - i. They are made up of Monosaccharide: Single sugars (glucose)
  - ii. Disaccharides are double sugars: Sucrose
  - iii. Polysaccharides: Starch and cellulose
- b. Lipids: Nonpolar substances that are not soluble in water
  - i. Include: Fats, phospholipids, steroids, and waxes
  - ii. Make up the outside of cell membranes

- iii. Store energy
  - iv. Fats can be saturated or unsaturated
- c. Proteins: A chain of molecules called amino acids linked together
- i. There are 20 different aa in proteins
    - 1. 10 of those your body can make on your own, the other 10 you need to consume in your diet
  - ii. Promote chemical reactions in your body = enzymes
  - iii. Collagen
  - iv. Hemoglobin
- d. Nucleic Acids: a long chain of nucleotides (sugar, base, and phosphate group)
- i. 2 types:
    - 1. DNA: Double stranded, found in your chromosomes, helps make proteins
    - 2. RNA: Single stranded, also helps make proteins

Another important molecule in your body: ATP: Adenosine triphosphate: Main energy unit of cells

Watch the following video: <https://www.youtube.com/watch?v=QWf2jcznLsY>

#### **4. Energy and Chemical Reactions**

- a. Energy: Ability to move or change matter. Exists in many forms:
  - i. Light, Hear, Chemical, Mechanical, Electrical
- b. Activation energy: The energy needed to start a chemical reaction. (Chemical “Push”)
- c. Enzymes: Substances that speed up a chemical reaction
  - i. Act as a catalysts, meaning they reduce the amount of activation energy required to start the reaction
  - ii. Help maintain homeostasis
  - iii. Enzymes can be affected or “denatured” by two different things:
    - 1. extreme pH
    - 2. extreme Temperature
- d. Substrate: A substance an enzyme has to bind to in order to work
- e. Active site: The location where the enzyme and substrate combine

Watch the following video on enzymes:

<https://www.youtube.com/watch?v=ok9esggzN18>

## AP BIOLOGY SUMMER READING ASSIGNMENT (Optional)

While this assignment is 100% optional, it would be a great way to begin preparation for the AP Exam in May. The exam challenges you to make cross connections between concepts in biology and the 4 big ideas below. This assignment would help to shape your way of thinking about biology to be most successful come May.

- Choose a book from the list below.
- For each of the 4 big ideas in AP Biology (listed below), identify two quotes that get you thinking about this big idea (that's 8 quotes total). Further explain the connection you see for each quote in a short paragraph. Type and print for the first day of class.
  - **Big Idea 1:** The process of evolution drives the diversity and unity of life.
  - **Big Idea 2:** Living systems use free energy and molecular building blocks to grow, reproduce and maintain homeostasis.
  - **Big Idea 3:** Organisms store, retrieve and transmit information
  - **Big Idea 4:** Living systems interact with each other, resulting in emergent properties

**The Teenage Brain, Amy Ellis Nutt and Frances E. Jensen.** Become metacognitive and learn about what current neuroscience says is going on in your brain as a teenager. The author is a mother and neuroscientist and although it's more written for adults looking to understand their children, there are many useful insights that you might find fascinating.

**Cooked, Michael Pollen.** Pollan explores how cooking transforms food and shapes our world. Broken into four parts for each natural element: fire, water, air, and earth. Watch the Netflix series when you've finished – it's very well done! (No pun intended).

**The Violinist's Thumb, Sam Kean.** The story of human DNA has a valid claim to being the greatest story ever told. Sam Kean tells it stage by stage, leading us through the complexities of such vast subjects as genetic theory, the mechanics of natural selection, and the origins of life itself.

**The Demon-Haunted World by Carl Sagan.** A book about what science really is, and how the scientific method fights ignorance and superstition. Very well written, and probably an enjoyable read for anyone. Approximately 200 pages.

**T. Rex and the Crater Of Doom by Walter Alvarez.** A book about the extinction of the dinosaurs and the search and collaboration of many scientists to develop the "mass impact" theory of extinction and discover the evidence to support it. Quite Short.

**The Beak of the Finch by Jonathan Weiner.** A book about the Finches of the Galapagos islands and evolution. Infinitely better than the Origin of the Species. Fairly long, at least 500 pages.

**Origin of the Species (Any Version) by Charles Darwin.** A boring book on evolution, but the original. Tried and true. Read an abbreviated version if you can find one – the regular one talks way too much about pigeons. Unabridged version approximately 450 pages.

**A Natural History of the Senses by Diane Ackerman.** A discussion of taste, touch, smell, sight, and hearing. Not terribly scientific, but written by a truly excellent writer. It discusses the history of perfume, the meaning of communal eating, and much more. Written for the layperson. About 200 pages.

**On Aggression by Konrad Lorenz.** A book about competition between tropical fish around the coral reef. Lorenz and competition are always AP Bio topics.

**Silent Spring by Rachel Carson.** A very famous book indeed. Recommended by The Times magazine. Mentioned in the 2003 AP Bio Exam and the Bio SAT II.

**Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body by Neil Shubin.**

Parsing the millennia-old genetic history of the human form is a natural project for Shubin, who chairs the department of organismal biology and anatomy at the University of Chicago and was co-discoverer of Tiktaalik, a 375-million-year-old fossil fish whose flat skull and limbs, and finger, toe, ankle and wrist bones, provide a link between fish and the earliest land-dwelling creatures.

**The Book of Life: An Illustrated History of the Evolution of Life on Earth by Stephen Jay Gould**

**(Editor).** A lucid, readily comprehensible, and largely up-to-date overview of the origins and evolution of life on earth, from the emergence of bacteria 4 billion years ago to that of Homo sapiens in recent geological time. Written by distinguished scientists, the text proceeds chronologically, giving an in-depth account of the fossil record. It is matched by hundreds of paintings, drawings, charts, and graphs that reinforce the authors' discussions.

**Your Brain on Food: How Chemicals Control Your Thoughts and Feelings Gary Wenk (Author).**

Why is eating chocolate so pleasurable? Can the function of just one small group of chemicals really determine whether you are happy or sad? Does marijuana help to improve your memory in old age? In this book, Gary Wenk demonstrates how, as a result of their effects on certain neurotransmitters concerned with behavior, everything we put into our bodies has very direct consequences for how we think, feel, and act.

**Dead Men Do Tell Tales: The Strange and Fascinating Cases of a Forensic Anthropologist.** William R. Maples, Michael Browning (Authors) Noted forensic anthropologist Maples, whose specialty is the study of bones, and freelance journalist Browning here recount Maples's criminal and anthropological investigations over the past 20 years. The book's strength is as a snapshot of the world of forensic scientists.

**The Seven Daughters of Eve: The Science That Reveals Our Genetic Ancestry Bryan Sykes (Author).**

Sykes is passionate about his work in decoding mitochondrial DNA and about using this knowledge to trace the path of human evolution. To lure readers into this specialized work, he relates personal and historical anecdotes, offering familiar ground from which to consider the science. A discussion of the history of genetics and descriptions of the early landmark work of Sykes and his associates culminate with his finding that 90 percent of modern Europeans are descendents of just seven women who lived 45,000 to 10,000 years ago.

**Welcome to Your Brain: Why You Lose Your Car Keys but Never Forget How to Drive and Other Puzzles of Everyday Life Sam Wang (Author), Sandra Aamodt (Author).** Neuroscientists Aamodt, editor-in-chief of Nature Neuroscience, and Wang, of Princeton University, explain how the human brain—with its 100 billion neurons— processes sensory and cognitive information, regulates our emotional life and forms memories. They also examine how human brains differ from those of other mammals and show what happens to us during dreams.

**The Biophilia Hypothesis Stephen R. Kellert (Editor).** Why is it that most of us find baby animals irresistibly cute? Why do so many people fear even the sight of snakes? Stephen Kellert and Edward Wilson, the prolific Harvard biologist, gather essays by various hands on these and other questions, and the result is a fascinating glimpse into our relations with other animals. Humans, Wilson writes, have an innate (or at least extremely ancient) connection to the natural world, and our continued divorce from it has led to the loss of not only "a vast intellectual legacy born of intimacy" with nature but also our very sanity. \*\*\*

**Plague of Frogs: Unraveling an Environmental Mystery William Souder (Author).** A Plague of Frogs is an ecological detective story, one that begins when a class of middle schoolers discovers an unusual number of deformed frogs in a pond on a southern Minnesota farm in 1995. William Souder spins a gripping tale of scientific investigation, environmental debate, and the frightening implications of what these deformed frogs mean for humanity. This is a superb account of a disturbing environmental happening, which finally leaves us wondering, as scientists do, over its larger implications."

**The Immortal Life of Henrietta Lacks Rebecca Skloot (Author).** From a single, abbreviated life grew a seemingly immortal line of cells that made some of the most crucial innovations in modern science possible. Henrietta Lacks was a mother of five in Baltimore, a poor African American migrant from the

tobacco farms of Virginia, who died from a cruelly aggressive cancer at the age of 30 in 1951. A sample of her cancerous tissue, taken without her knowledge or consent, as was the custom then, turned out to provide one of the holy grails of mid-century biology: human cells that could survive--even thrive--in the lab.

**Genome: The Autobiography of a Species in 23 Chapters Matt Ridley (Author).** Each chapter pries one gene out of its chromosome and focuses on its role in our development and adult life, but also goes further, exploring the implications of genetic research and our quickly changing social attitudes toward this information. Genome shies away from the "tedious biochemical middle managers" that only a nerd could love and instead goes for the A-material: genes associated with cancer, intelligence, sex (of course), and more.

**Lives of a Cell: Notes of a Biology Watcher Lewis Thomas (Author).** Thomas explores the world around us and examines the complex interdependence of all things. Extending beyond the usual limitations of biological science and into a vast and wondrous world of hidden relationships, the book explores in personal, poetic essays topics such as computers, germs, language, music, death, insects, and medicine. \*\*\*

**The Youngest Science: Notes of a Medicine-Watcher Lewis Thomas (author).** A doctor's fascinating view of what medicine was, and what it has become. Thomas first learned about medicine by watching his father practice in an era when doctors comforted rather than healed. Looking back upon his experiences as a medical student, young doctor, and senior researcher, Thomas notes that medicine is now rich in possibility and promise.

**A General Theory of Love Thomas;Amini, Fari;Lannon, Richard Lewis (Author).** A powerfully humanistic look at the natural history of our deepest feelings, and why a simple hug is often more important than a portfolio full of stock options. The grasp of neural science is topnotch, but the book is more about humans as social animals and how we relate to others--for once, the brain plays second fiddle to the heart.

**And the Waters Turned to Blood Rodney Barker (Author).** Don't drink the water. Don't swim in it, fish in it, or even bathe in it. Rodney Barker's book details the latest plague to visit our shores: Pfiesteria piscicida, the "cell from hell," an aquatic microorganism that causes sufferers to exhibit symptoms similar to Alzheimers or multiple sclerosis and the government's attempts to suppress reports.

**The Hot Zone: A Terrifying True Story Richard Preston (Author).** The dramatic and chilling story of an Ebola virus outbreak in a suburban Washington, D.C. laboratory, with descriptions of frightening historical epidemics of rare and lethal viruses. More hair-raising than anything Hollywood could think of, because it's all true.

**The Demon in the Freezer Richard Preston (Author).** On December 9, 1979, smallpox, the most deadly human virus, ceased to exist in nature. After eradication, it was confined to freezers located in just two places on earth: the Center for Disease Control in Atlanta and the Maximum Containment Laboratory in Siberia. Since the fall of the Soviet Union in 1991 a sizeable amount of the former Soviet Union's smallpox stockpile remains unaccounted for, leading to fears that the virus has fallen into the hands of nations or terrorist groups willing to use it as a weapon.

**The Botany of Desire: A Plant's-Eye View of the World Michael Pollan (Author).** Pollan's fascinating account of four everyday plants and their co-evolution with human society challenges traditional views about humans and nature. Using the histories of apples, tulips, potatoes and cannabis to illustrate the complex, reciprocal relationship between humans and the natural world, he shows how these species have successfully exploited human desires to flourish.

**In Defense of Food: An Eater's Manifesto Michael Pollan (Author).** As an increasing number of Americans are overfed and undernourished, Pollan makes a strong argument for serious reconsideration of our eating habits and casts a suspicious eye on the food industry and its more pernicious and misleading practices. Listeners will undoubtedly find themselves reconsidering their own eating habits.

**The Omnivore's Dilemma: A Natural History of Four Meals Michael Pollan (Author).** In a journey that takes us from an "organic" California chicken farm to Vermont, Pollan asks basic questions about the moral and ecological consequences of our food. Critics agree it's a wake-up call and, written in clear, informative prose, also entertaining.

**Wicked Plants: The Weed That Killed Lincoln's Mother and Other Botanical Atrocities Amy Stewart (Author), Briony Morrow-Cribbs (Illustrator).** A tree that sheds poison daggers; a glistening red seed that stops the heart; a shrub that causes paralysis; a vine that strangles; and a leaf that triggered a war. Stewart takes on over two hundred of Mother Nature's most appalling creations. It's an A to Z of plants that kill, maim, intoxicate, and otherwise offend.

**Wicked Bugs: The Louse That Conquered Napoleon's Army & Other Diabolical Insects Amy Stewart (Author).** With wit, style, and exacting research, Stewart has uncovered the most terrifying and titillating stories of bugs gone wild. It's an A to Z of insect enemies, interspersed with sections that explore bugs with kinky sex lives ("She's Just Not That Into You"), creatures lurking in the cupboard ("Fear No Weevil"), insects eating your tomatoes ("Gardener's Dirty Dozen"), and phobias that feed our (sometimes) irrational responses to bugs ("Have No Fear"). \*\*\*