

Book Review

Jorge A. Santiago-Blay¹

The Bad Food Bible. How and Why to Eat Sinfully

by Aaron Carroll (MD), with a Foreword by Nina Teicholz. 2017.

Houghton Mifflin Harcourt. Boston Massachusetts, USA. 234 pp.²

Key Words: Nutrition, food consumption, epidemiology, facts, facts-based decisions, science-based decisions, evidence-based decisions, carbohydrate vs. lipids role in obesity

Myths, like people, can be deceptive. Using fact-based, scientific reasoning, Dr. Aaron Carroll's *The Bad Food Bible* demolishes many conventional beliefs related to food consumption. The iconoclastic tone of his work begins from the title (e.g., "bad food" and "Bible" are juxtaposed!). This book resonated with me as I have performed idol-challenging "experiments" since boyhood. Imagine how many behaviors (e.g., "don't eat raw dough") we have acquired because someone else said so. If *The Bad Food Bible* changes anyone into someone who regularly asks, "Was that statement about an alleged health-related quality of a food item garnered through a randomized control trial, or RCT?", then one of Dr. Carroll's writing goals, to develop a healthy philosophy of eating that works for you, has been fulfilled. Reading/listening to *The Bad Food Bible* was a phenomenal learning experience and I recommend it to anyone interested in thinking critically about food, health, and, the realities of scientific research.

The *Foreword*, written by Nina Teicholz, made me remember people who come across as zealots of science as well as those who seem to have anti-science attitudes. Beyond the annoyance those extremes may cause, they instill in some of us the desire to do a better job, both in research and in communicating science, particularly to the public. People who are "on the fence" may become more interested in good science, especially if made accessible to all.

What are the basic chemicals that our bodies use? Our bodies use and/or process many kinds of substances (Figures 1-2). Many of those materials are carbon-based, or "organic" (e.g., carbohydrates, lipids – a chemically hyperdiverse group, nucleic acids, and proteins). Vitamins are also organic but are needed in smaller amounts. Other chemicals are inorganic, such as the minerals our bodies need to function properly (e.g., sodium, potassium, calcium, iodine, magnesium, chloride, and many others).

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² Audiobook available as an MP3-CD. Performed by Jeff Cummings and Kate Hudd. BrillianceAudio, Brilliance Publishing, Inc. Grand Haven, Michigan 49417-2820 USA. *The Bad Food Bible* was an enjoyable listen over by drives to and from Washington, DC this winter 2018.

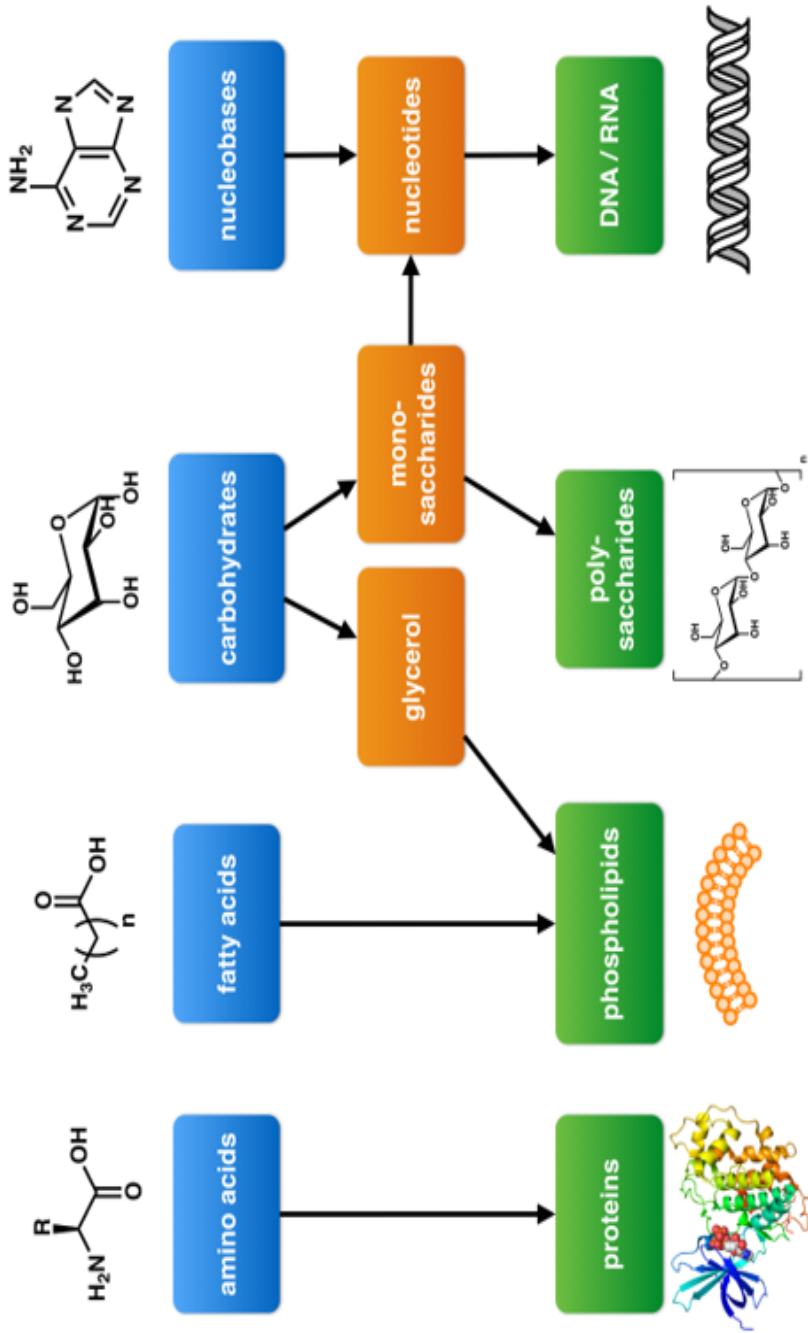


Figure 1. Major organic macromolecules of organisms. Attribution: By Bøghog (Own work) [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>)], via Wikimedia Commons. Note the (highly simplified) network of chemical transformations that are possible between the member of the different groups of macromolecules. File URL: https://upload.wikimedia.org/wikipedia/commons/0/0a/Building_blocks_of_life.png.

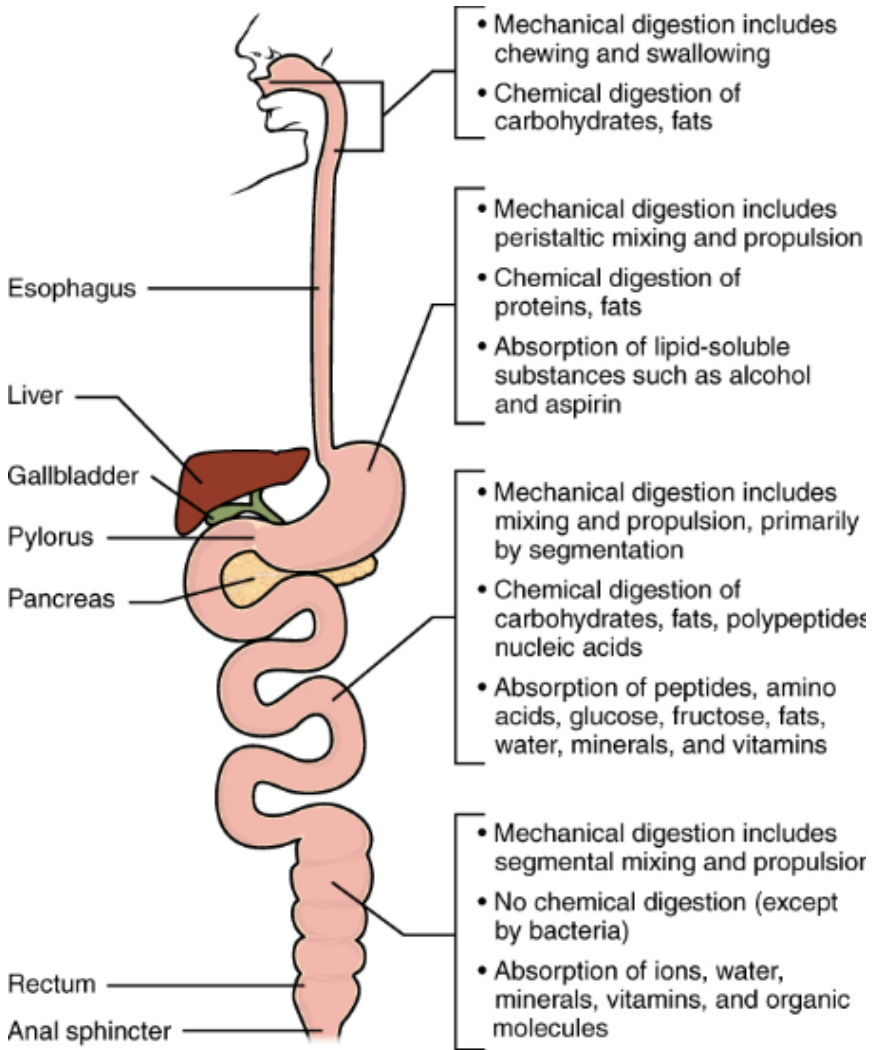


Figure 2. The human digestive system, briefly explained. [https://commons.wikimedia.org/wiki/File%3A2426 Mechanical and Chemical DigestionN.jpg](https://commons.wikimedia.org/wiki/File%3A2426_Mechanical_and_Chemical_DigestionN.jpg) . Attribution: By OpenStax College [CC BY 3.0]. File URL: <http://creativecommons.org/licenses/by/3.0/>], via Wikimedia Commons.

Why should we be concerned about nutrition? Epidemiological studies indicate that approximately two thirds of the population of the USA and other “depleted” countries is overweight and this figure is increasing. This propensity among those in the USA to overeat is not new. Sir Joseph Dalton Hooker (Kew

Gardens, England, UK), one of the most influential botanists of the late 19th and early 20th century, communicated his impressions about this in his trip to the US to his counterpart, Asa Gray (Harvard University, Cambridge, Massachusetts, USA). On the other extreme, many among us do not ingest enough calories to “fuel” our bodies (undernutrition) or do not eat enough of the nutrients we need (malnutrition). Many health conditions, such as coronary heart disease, have been directly linked to overabundance of food items (and lack of sufficient exercise) or lack of important foods items (e.g., citric acid and scurvy; vitamin B1 and beri beri).

The *Introduction* lays down the fundamentals for the rest of the book. Amidst oodles of opinions, including a former student of my wife who used to say, “a fact is whatever I say is a fact”, it is not surprising that anyone asks, “is there any *terra firme* in nutrition, or on anything?”. I consider this a strategy to undermine science making facts either relative or non-existing (fake). In contrast, Dr. Carroll advocates for science, not fear, and using replicable observations, or facts, not just opinions. Although well-intentioned, not all scientific studies should be given equal weight. Broadly communicating, there are two major types of studies: 1) observational (e.g., single observations, case studies, cross sectional with/without controls, and cohorts or organisms followed through time) and 2) experimental (e.g., randomized control trials, or RCTs, and meta-analyses of RCTs). While observational studies may show correlation, properly-designed, large scale (in time and space, involving many people for a prolonged time) may show causation. Never forget that correlation does not necessarily imply causation. The punchline of *The Bad Food Bible* is that there is not enough adequate evidence against salt, cholesterol, butter, genetically modified organisms (GMOs), gluten, alcohol, and many others.

Other major points in this information-rich *Introduction* include, first, the fact that many health-related papers are limited in numerous ways: 1) by organisms being studied [e.g., studies that use (male) rodents are not as representative of the variation in humans] and 2) by variable studied [e.g., following processes or markers, such as blood sugar levels, does not necessarily indicate whether one has the outcomes, such as diabetes]. Second, the broad public needs practical, quality scientific information communicated in accessible language. This highlights the importance of having only exceptional faculty members teaching science courses for non-science majors to foster in students the desire to understand and evaluate the scientific literature as rendered in the popular media as well as the original sources, if they wish.

Chapter 1, *Butter: On fats*, reveals many little-known facts about lipids. As the rise in cardiovascular diseases was noticed in the USA (circa 1950's), there was a tug of war between those assigning blame to fats [a major category of lipids, which are solid at “room temperature” or between 15°Celsius (59° Fahrenheit) and 25°C (77°F)] and those who considered carbohydrates were responsible. For decades, “fats make you fat” was considered a truism. Yet, not

all lipids are created equal. Saturated fats, those that have most, or all their carbon atoms endowed with a hydrogen atom, as in the case of butter, may have some benefits as do some unsaturated *cis* (the hydrogen atoms in similar orientations of the double bond) fats (e.g., avocado, some nuts, and others). Oils are liquid at room temperature and considered less desirable for consumption than a solid spread. To make oils solid, hydrogenation, or the addition of hydrogen atoms, was widely attempted and margarines began populating refrigerators. Regrettably, hydrogenation tended to be in the *trans* position (the hydrogen atoms are located in opposite orientations of the double bond, Figure 3). Humans do not have the chemical machinery, enzymes, to digest the *trans* fats. *Trans* fats are bad for health but the evidence for a connection between fats and cardiovascular disease is weak, according to Dr. Carroll.

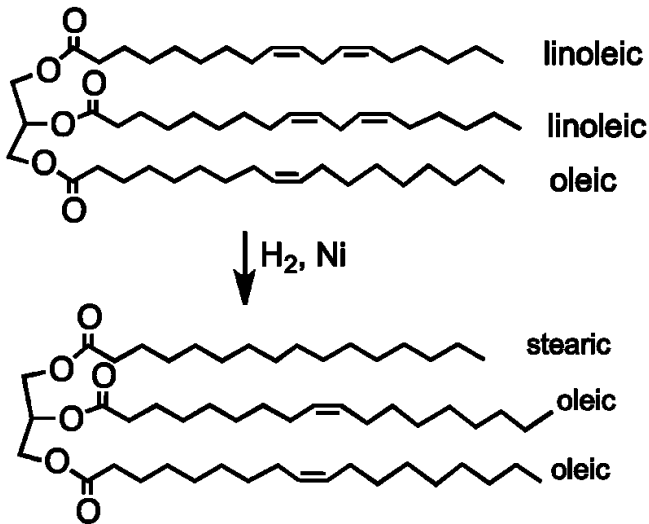


Figure 3. Hydrogenation of oils. This reaction often resulted in the production of trans fats that are harmful to human health. Image from <https://en.wikipedia.org/wiki/Hydrogenation#/media/File:H2forMargerin.png>. Attribution: By Smokefoot - Own work, CC BY-SA 3.0. File URL: <https://commons.wikimedia.org/w/index.php?curid=20414164>

Another myth that goes out the window is the alleged necessity of calcium and vitamin supplements in humans after two years or so of age, through the ingestion of milk to support bone growth. According to Dr. Carroll, the “milk-industrial complex”, has propagated the scientifically unsupported idea that “milk [from other species] does the [human] body good”. Instead, supplements are only beneficial in cases of people with nutritional deficiencies.

Whether one advocates for the vegetarian or the carnivorous “agenda”, Chapter 2, *Meat: On proteins* is for you. Meat, Dr. Carroll argues, has been

associated to the increase in cardiovascular diseases in the USA. However, while in the last few years, those living in the USA have decreased their average meat consumption, cardiovascular diseases have not shown a corresponding decrease. Besides the issue of what counts as “meat”, and that not all cuts of meat are equal in nutritional value, some fish (particularly those rich in omega-3 unsaturated fatty acids and low in mercury), poultry, and mammals are better than others. If one prefers a non-meat diet, basing it on the alleged dangers of meat does not cut it. Instead, personally, as one who prefers a vegetarian lifestyle, I think of the greater ecological efficiency of growing plants as compared to raising animals. By wisely combining nutritionally diverse types of veggies, one can attain a balanced diet and enjoy the immense pleasures of delicious meals.

In Chapter 3, *Eggs: On cholesterol*, the reader may be up for a surprise. Besides the well-known fact that there are several types of cholesterol, in simple terms, low density lipoproteins (or LDLs, or “bad” cholesterol) and high-density lipoproteins (or HDLs, or “good” cholesterol), according to Dr. Carroll, there is no unmistakable evidence, as obtained through RCTs, that dietary cholesterol is related to cholesterol blood levels.

A similar story is revealed in Chapter 4, *Salt: On sodium*. In the cases of salt, as well as cholesterol, I suspect there are genetic differences in people’s ability to respond to extreme concentrations. In both cases, moderation seems to be the more sensible recommendation, unless one is medically advised otherwise.

Chapter 5, *Gluten: On grains*, discusses one of the most recent developments in dietary innovations, gluten-free foods. Figure 4 represents a greatly enlarged grain, or seed, of wheat. True cereals, plants grown to eat their grains, belong in the grass plant family, the Poaceae. This is one of the most economically important plant families in the world and it has fed humans for millenia. What can be so bad about grains? A summary is provided in Figure 5.

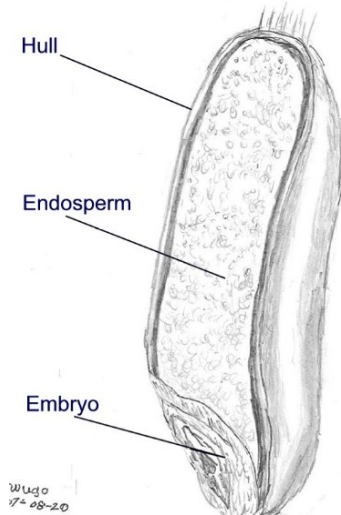


Figure 4. A wheat seed, genus *Triticum*. Most of the gluten, two proteins, comes from the endosperm, or source of energy for the embryo germinate. Gluten gives the dough its elastic properties. Gluten is also present in rye, barley, and triticale. Attribution: By Wugo at English Wikipedia (Transferred from en.wikipedia to Commons.) [Public domain], via Wikimedia Commons. File URL: https://upload.wikimedia.org/wikipedia/commons/7/73/Wheat_seed.jpg

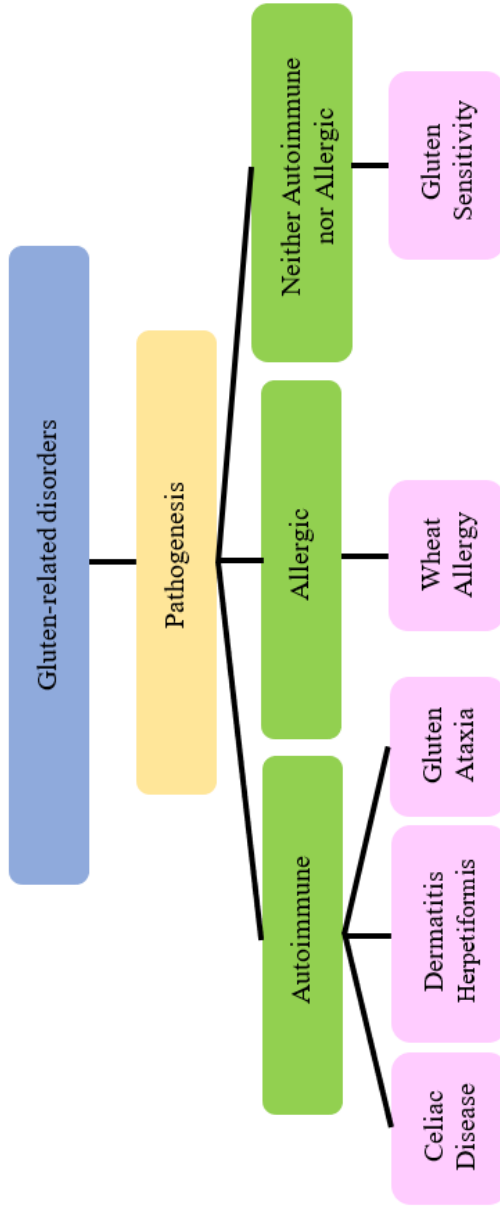


Figure 5. Some gluten-related disorders. Modified and simplified from: https://upload.wikimedia.org/wikipedia/commons/c/c9/Gluten-related_disorders.jpg. File URL: By Dr. Schär AG (Dr. Schär AG) [Public domain], via Wikimedia Commons.

People with wheat allergies must avoid anything containing wheat, although it is not clear whether they should also avoid other gluten-laden cereals. Celiac disease, on the other hand, is an immune reaction to gluten. People with celiac disease, must avoid gluten. Both conditions are rare, with less than 1% prevalence in the USA. Finally, gluten sensitivity (also known as non-celiac gluten sensitivity) is not an allergy or an autoimmune disease and it is not clear what mechanism causes this condition or whether it is “real”. Suggesting that terrible things may happen because of eating something, may make people report that something has, indeed, happened. This phenomenon is called the “nocebo effect”. Interestingly, besides their higher cost, gluten-free products may not be as beneficial and may be outright harmful.³

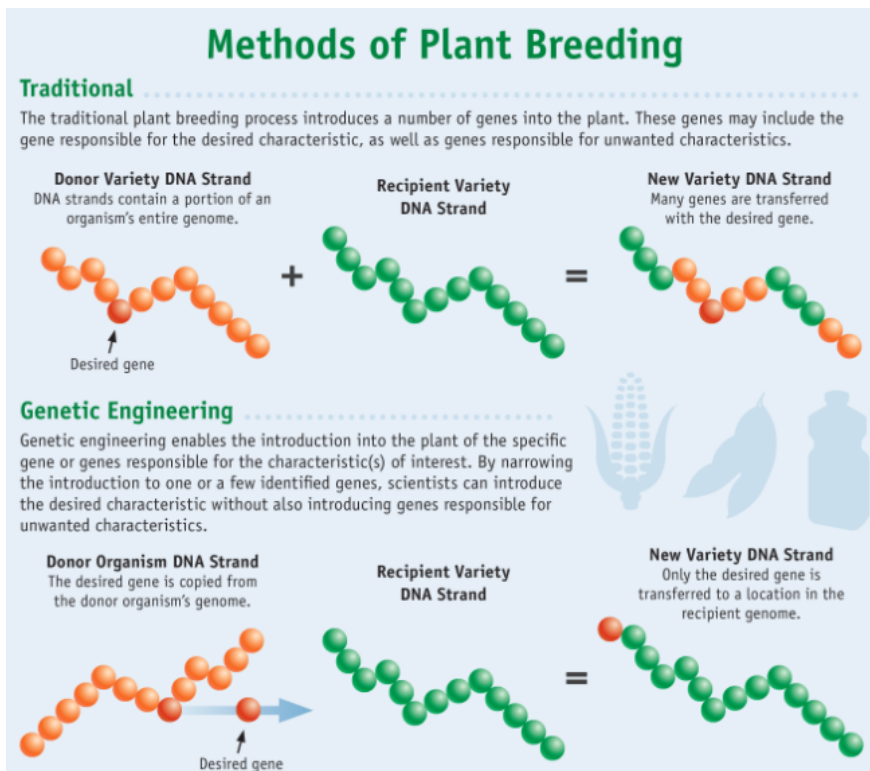


Figure 6. A comparison of traditional plant breeding and genetic engineering. Credit: U.S. Food and Drug Administration. File URL: <https://www.flickr.com/photos/fdaphotos/8737954801>

³ Other conditions (not mentioned in *The Bad Food Bible*) apparently not related to gluten are: Irritable Bowel (Colon) Syndrome and Crohn's Disease. Both are inflammatory diseases.

Another controversial topic discussed in *The Bad Food Bible* is *GMOs: On genetically modified organisms* (Chapter 6). In the 1960's, the so-called "Green Revolution" was seen as a savior of world hunger. Some problems, such as a likely famine in India, were temporarily solved. Yet, unfamiliar problems appeared for which traditional methods of crop breeding, which generally take too long, were not adequate. Molecular biology, through the insertion of genes from foreign organisms (Figure 6, previous page), like in word processing, expedited and broadened the possibilities of plant breeding. In contrast, Dr. Carroll argues, GMOs obtained through the typical molecular tools of biotechnology (Figure 7) are no riskier to eat than conventionally-grown foods. Also, are organisms resulting from the genetic manipulations directly in the DNA, like those produced using CRISPR-Cas9 technology (Figure 8) to be considered GMOs also? Who are the legal owners of the genetically-modified organisms?

Molecular Cloning

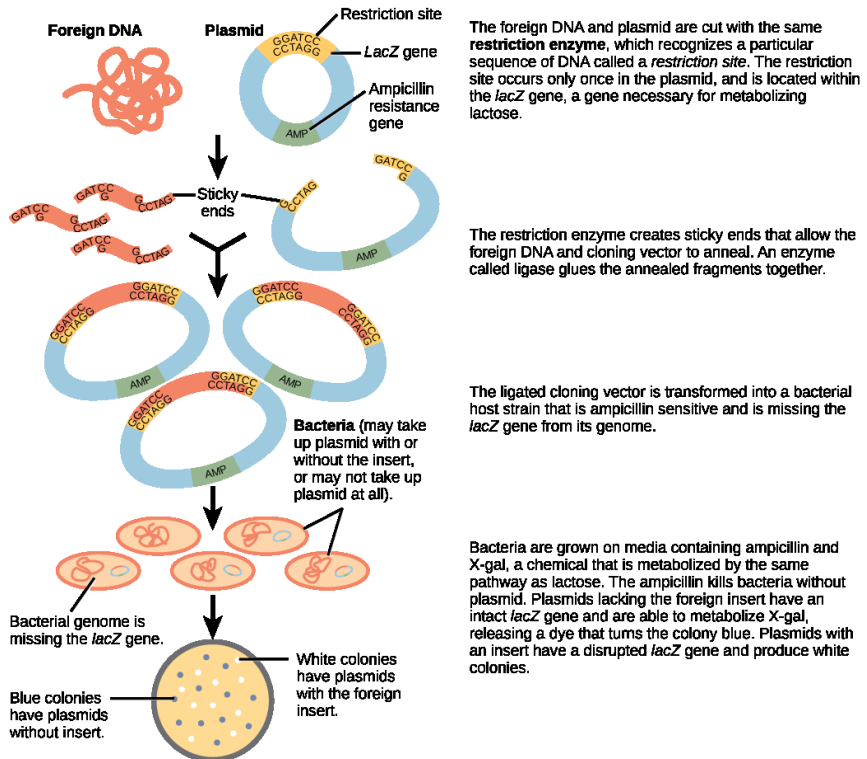


Figure 7. Genetic engineering using the typical tools of biotechnology, involving the insertion of foreign DNA. Attribution: By CNX OpenStax [CC BY 4.0] (<http://creativecommons.org/licenses/by/4.0>), via Wikimedia Commons. File URL: https://upload.wikimedia.org/wikipedia/commons/e/ef/figure_17_01_06.png

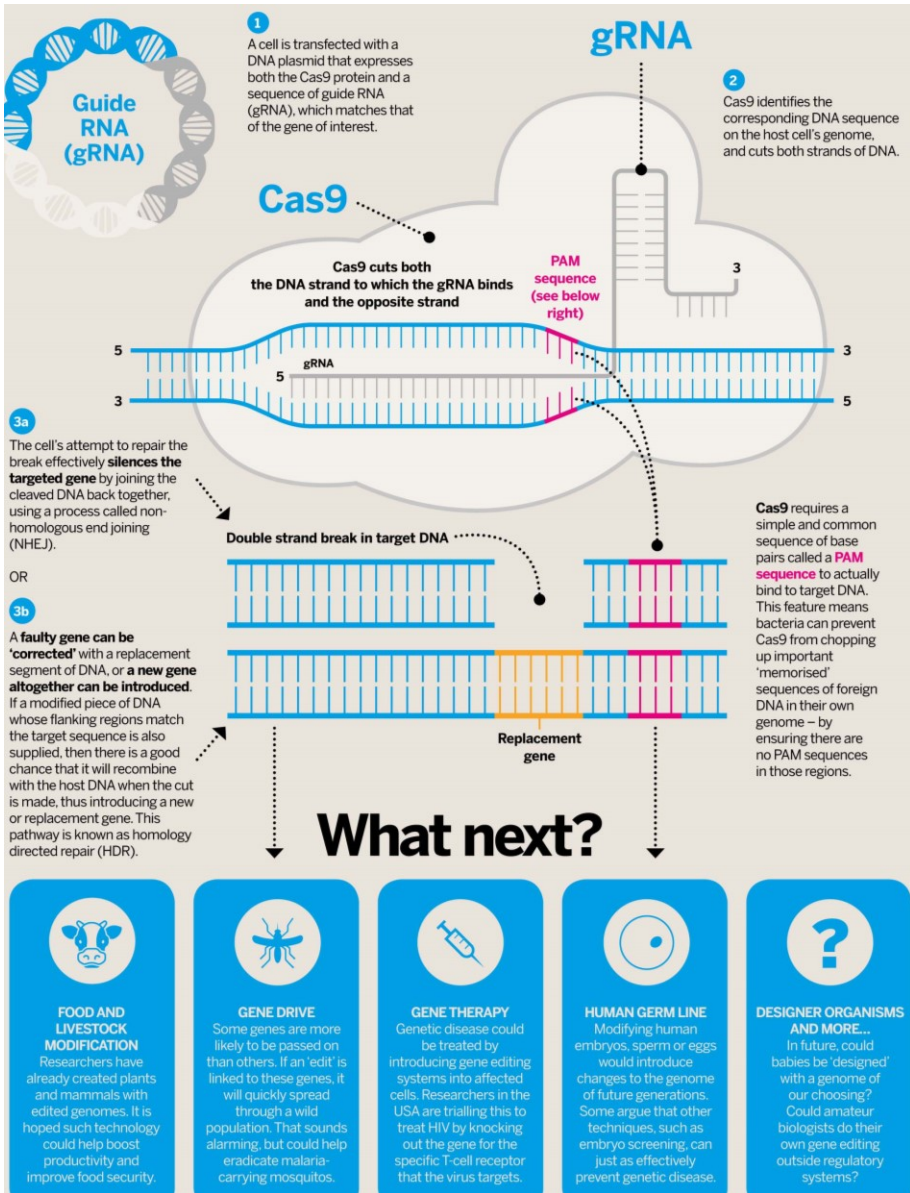
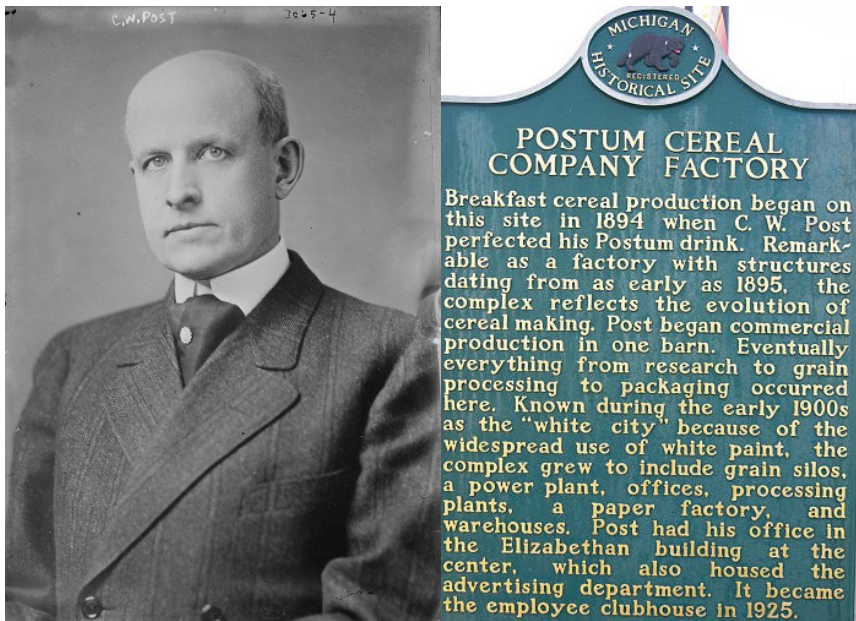


Figure 8. How does CRISPR-Cas9 technology works. By J LEVIN W (Own work) [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>)], via Wikimedia Commons. File URL: <https://upload.wikimedia.org/wikipedia/commons/7/78/CRISPR-Cas9-biologist.jpg>

Chapter 7, *Alcohol: On booze* discusses the benefits and harmful effects of alcohol. Smaller amounts of alcohol appear to be beneficial for cardiovascular health as well as cognition and does not to increase the risks of cancer. However, the same cannot be said for heavy drinkers as dangers the dangers of drinking excessively far outweigh than the small health benefits gained from moderate drinking. Thus, if one cannot drink responsibly and in moderation, it is better to not get started.

Are you craving coffee? Chapter 8, *Coffee: On caffeine*, discusses this relatively recent addition to the human diet. One of my dearest friends, drinks coffee, up to eight cups (nearly 2 liters) daily. This person developed bladder cancer. Does that necessarily mean that coffee gave this person cancer? No, that story is just anecdotal evidence. Using the same logic of the *Introduction*, Dr. Carroll debunks many of the myths pertaining to the alleged unhealthy consequences of drinking coffee, including those created by Charles Williams (C. W.) Post and his anti-coffee propaganda (Figures 9-10).



Figures 9-10. 9. Charles Williams Post, creator of Postum and numerous cereal products in the USA. Image possibly taken between 1910 and 1915. Repository: Library of Congress, Bain Collection URL: hdl.loc.gov/loc.pnp/ggbain.16071 Call Number: LC-B2- 3065-4. Source: [https://en.wikipedia.org/wiki/C. W. Post#/media/File:Post_5416186694_12003bd602_o.jpg](https://en.wikipedia.org/wiki/C._W._Post#/media/File:Post_5416186694_12003bd602_o.jpg) . 10. Historical site marker for Postum Cereal Factory, owned by Post, in Battle Creek, Michigan, USA, manufacturing site of Postum, a coffee alternative made from cereals and manufactured over 100 years old. Author: Attribution: By rossograph (Own work) [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0/>)], via Wikimedia Commons. File URL: https://upload.wikimedia.org/wikipedia/commons/1/13/Postum_Cereal_Company_Factory.jpg

Such myths include reduction in calcium uptake by bones and dehydration, among other unsupported ideas. In contrast, large studies suggest that coffee has numerous health benefits, including augmented brain health and improved memory, diabetes, cancer, and many others. Coffee has no prolonged effect on heart rate or cholesterol concentration. All of this made me wonder what substances cause the health benefits attributed to coffee and whether those benefits extend to other members of the coffee plant family, the Rubiaceae. Coffee is not recommended for children as caffeine, particularly in excess, tends to keep people awake and/or make them jittery.

If you are ready for a “sweet” controversy, then read Chapter 9, *Diet Sodas: On carbohydrates and artificial sweeteners*. Specifically, what happens when table sugar, or sucrose enters the body? Our body breaks sucrose into fructose and glucose. Glucose is a key energy-rich supply. The glucose is absorbed into our bodies through the small intestine. Excess glucose is normally stored in our skeletal muscles and liver as a much larger molecule, called glycogen (Figure 11).

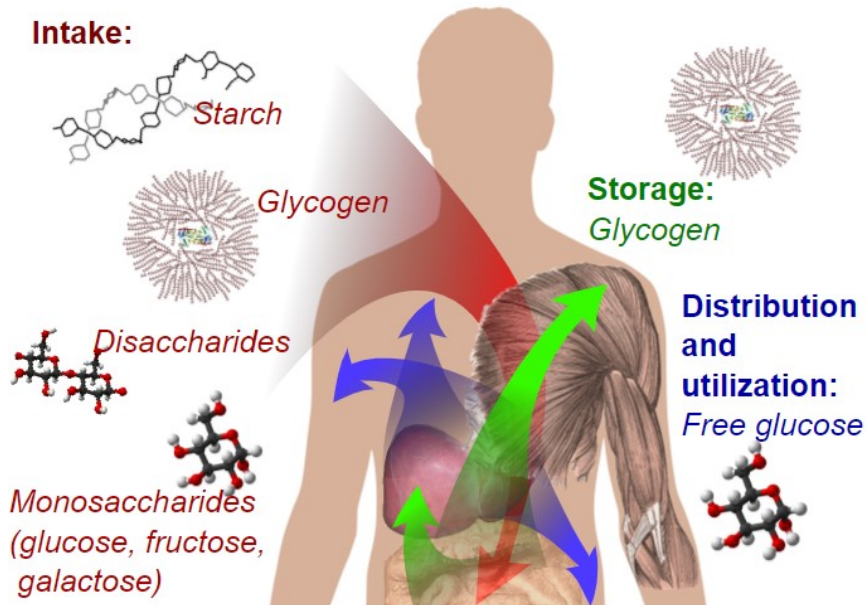


Figure 11. Typical (and simplified) metabolism of glucose in the human body. Attribution: By Mikael Häggström [Public domain], via Wikimedia Commons. File URL: https://upload.wikimedia.org/wikipedia/commons/4/4c/Glucose_metabolism.png

Which is worse: artificial sweeteners or carbohydrates, such as sucrose? In the next page, I provide a visual representation of what happens with most foods as they enter our bodies (Figure 12).

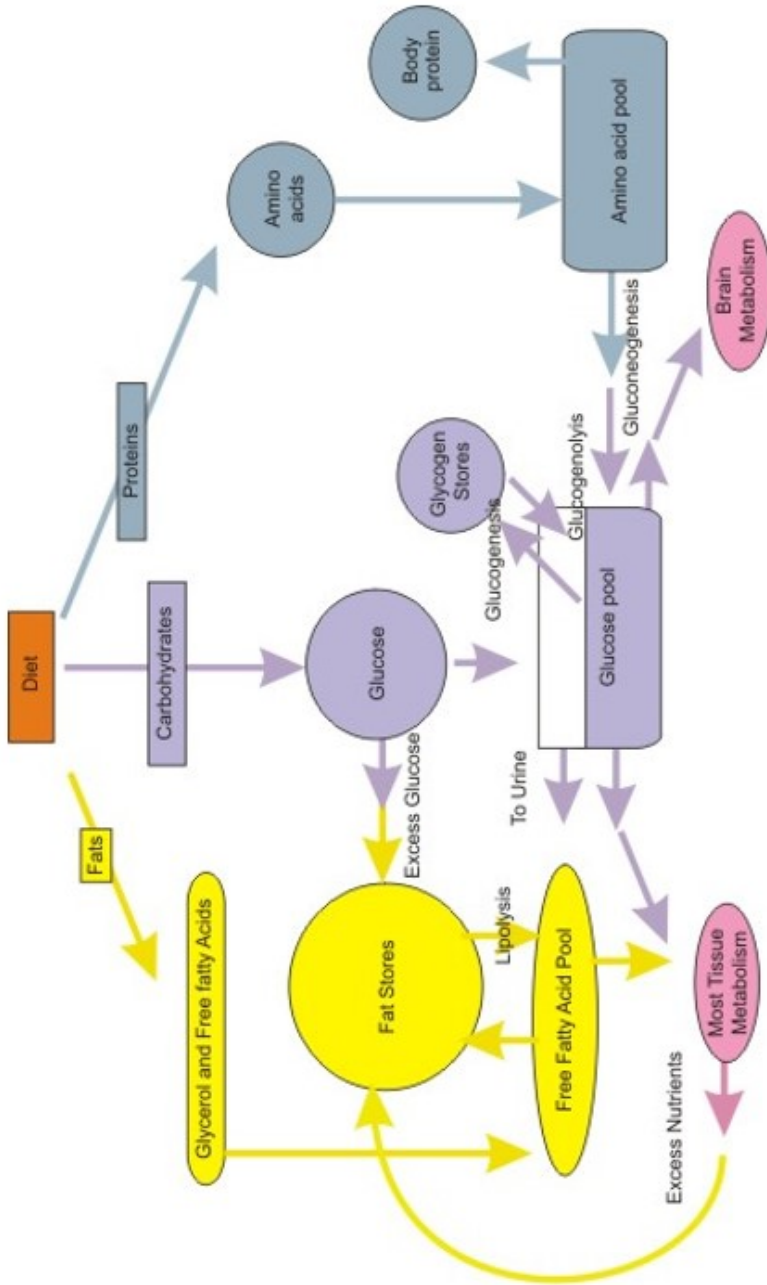


Figure 12. Typical (and greatly simplified) metabolism of major dietary foods in humans. Note the numerous chemical interconversions possible between different metabolic products. Attribution: By Bounphreyfr (Own work) [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0>) or GFDL (<http://www.gnu.org/copyleft/fdl.html>)], via Wikimedia Commons. File URL: https://upload.wikimedia.org/wikipedia/commons/0/04/Nutrition_Metabolic_Summary.jpg

Of great interest to me as a scientist profoundly interested in the history and philosophy of science were Dr. Carroll’s remarks on the Sugar Research Foundation, currently known as the Sugar Association. During the 1960’s, the Sugar Research Foundation tried to influence cardiovascular disease science by pointing on the direction of lipids (and away from sugars) as the bad dietary guys and gals, very much like the two (funny) rogue cows have been doing since 1995 in the Chick-fil-A marketing campaign, “Eat Mor Chikin”. This was like a tables, ladders, and chairs wrestling match between advocates of lipids (especially fats) and advocates of carbohydrates. Although, at the time, carbohydrates were exonerated, recent scholarship had uncovered the scandal involved in this conclusion. The real public enemy number one, Dr. Carroll says, is “added sugar”, not the carbohydrates naturally present in food items. Excess consumption of sugars is unhealthy. For example, sugars are associated with type 2 diabetes. Two of several types of diabetes are summarized below and the mechanisms of glucose processing (or metabolism) are summarized in Figure 13.

Diabetes type	Causes	Consequences/Prevention
1	Autoimmune disease; little or no insulin production	Low blood sugar levels; inject insulin to keep healthy blood sugar levels.
2	Insensitivity to insulin, body does not respond to insulin appropriately	Maintaining a healthy weight, eating sensibly, and exercising regularly

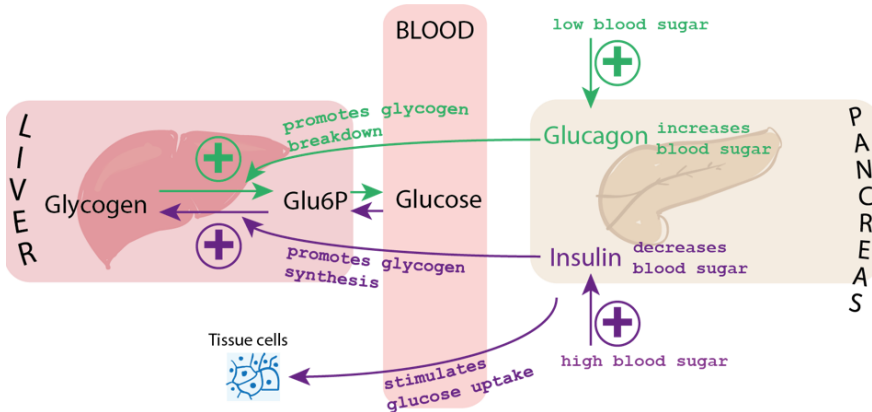


Figure 13. Mechanism of glucose metabolism in a typical human body. Attribution: By C. Muessig (Own work) [CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)], via Wikimedia Commons File URL: https://upload.wikimedia.org/wikipedia/commons/e/e0/Blood_glucose_control.png

As for artificial sweeteners, Dr. Carroll argues that no strong link between cancer, neurologic diseases, obesity and the artificial sweetener, saccharin, using RCTs have been established for humans. As in everything, think critically and eat in moderation.

How many things do we add to our food? Chapter 10, discusses one of them: *MSG: On monosodium glutamate*. Glutamate is the salt of glutamic acid, one of the common amino acids or building blocks of proteins (Figure 14), glutamic acid. Many people find that MSG enhances the savory/salty taste of meals. Unfortunately, many health conditions, such as allergies, migraines, etc. have been linked to MSG. Yet, according to Dr. Carroll, none of the evidence provided in papers raises to the gold standard: RCTs. If some product does not sit well with you, avoid it, unless you have a good reason to behave otherwise.

Chapter 11, *Non-organic foods: On conventionally grown foods, vegetables, and meat*, discusses “organic” products. Besides meaning compounds containing the carbon atom, the word “organic” also refers to food growing practices that minimize or avoid the use of human-made synthetic products not normally found in nature. As Dr. Carroll, often I wonder if because something is “natural” or “organic”, does it also necessarily imply that is good for the environment of which we form a part of? I wonder if a contaminant is under a human-prescribed limit, does it mean it is OK for us to ingest it or it is OK for the environment?

The last portion of *The Bad Food Bible* includes a *Conclusion: Simple Rules for Healthy Eating*. So, what is dietary health? A diet that works for each of us, within our circumstances. Here are Dr. Carroll’s rules (condensed by me). 1) Make sure you know if you have dietary restrictions or allergies and eat accordingly. 2) Be aware of what you eat, including calories, particularly those ingested easily, such as those acquired through liquid foods. 3) Eat slowly. 4) Get as much as possible of your “nutrition from a variety of completely unprocessed foods”, ideally at home where you have some control over seasoning, portion size, additives, etc. 5) Drink water abundantly; coffee, tea, and alcohol are OK, in moderation. 6) Use critical thinking on everything, including food choices. And, “how many more myths related to human nutrition and genetics there must be out there?” Heartfelt *Acknowledgments*, abundant and useful *Notes*, and an *Index*, that works as far as I tested it, conclude this delightful tome. “The Bottom Line” sections located at the end of each chapter and the *Conclusion* are good take home messages to remember.

After all is read (or listened to), what are my take home messages? Question everything pertaining to health advice, always asking “are the statements being made the result of large scale, randomized control trials”? Pertaining to dietary choices, do your best, in good conscience, and according to your possibilities. Above all, enjoy what you eat, in moderation. If one is trying to lose weight, establish sensible goals, keeping health as the key goal. My former primary health care provider, used to say that 80% of the battle concerning weight loss is in what we eat and 20% what we “burn” through exercise. If I can do it, anyone can do it!

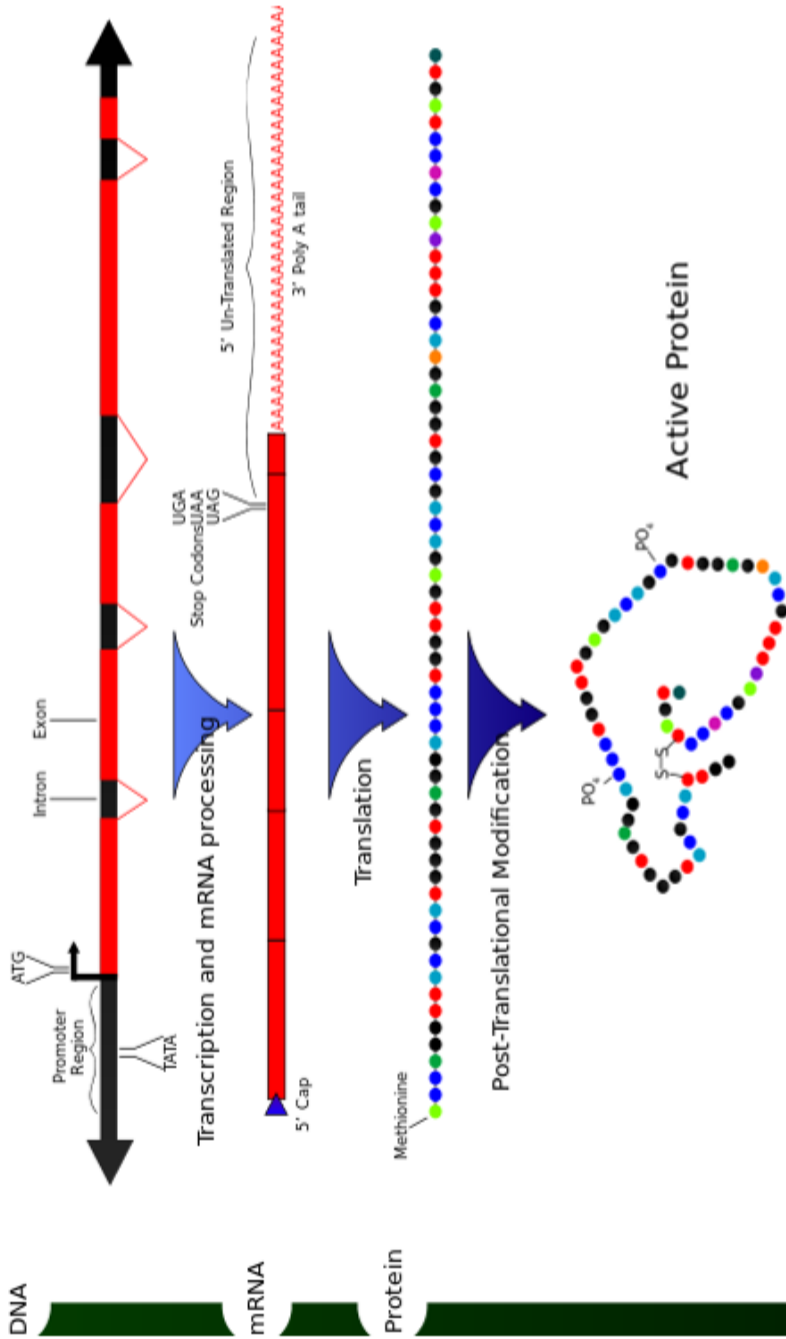


Figure 14. Central “dogma” of genetic information flow in humans and other eukaryotes. Each small circle to the right of the word “Protein” represents an amino acid, the building blocks of proteins. Glutamic acid is an example of an amino acid. By: Mike Jones (Adenosine at English Wikipedia). File URL: https://en.wikipedia.org/wiki/Central_dogma_of_molecular_biology#/media/File:Cdmb.svg

To the printed version, I would have considered adding illustrations to facilitate learning as well as sections with pertinent background information for readers who may need it. As I was savoring *The Bad Food Bible*, I was wondering, “How much genetic diversity there is in humans (i.e., by gender, by stage of development, by environmental exposure, etc.) in matters pertaining to nutrition (besides that related to genetically-caused nutritional deficiencies for which some science-based supplements are necessary)? And, How the typical human diet has changed through human evolution and more recently?”

Thanks Dr. Carroll for trying to “restore sanity” to our food eating behaviors!

Acknowledgements

I wholeheartedly thank Dr. Margaret Schwinghammer (Alexandria, Virginia, USA) and Josh Nash (Johns Hopkins University, Baltimore, Maryland, USA) for their editorial assistance. The errors remaining in this write-up are solely my responsibility.

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A Buddha bowl, lovingly prepared and photographed by Suzanne Shaffer.