

**LITTLE BLACK BOOK  
OF JUNK  
SCIENCE**

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Senior Fellow of Biomedical Science, ACSH

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A publication of the



AMERICAN COUNCIL  
ON SCIENCE AND HEALTH

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Publisher name: American Council on Science and Health  
Title: Little Black Book of Junk Science  
Authors: Alex Berezow, Ph.D.  
Subject (general): Science and Health  
Publication Year: 2017  
Binding Type (i.e. perfect (soft) or hardcover): Perfect  
ISBN: 978-0-9972530-0-9

I n one handy little volume, *The Little Black Book of Junk Science*, we provide an A to Z (okay, A to Y) guide to the most common myths and misunderstandings surrounding health fads, diets, chemicals, and other pseudoscience. We hope it provides a small dose of sanity in a world full of junk science.

A.B.B.



## **ABSOLUTE RISK**

What's the difference between .5% and 50%? A little or a lot when dealing with Absolute and Relative risk. If a paper claims eliminating bacon cuts your risk of heart attack by 50%, that sounds important. Unless the absolute risk goes from 1% to .5% and the relationships between bacon and heart attacks are unclear. Absolute risk is misused often in food studies. When benefits are presented in relative terms, while harms or side effects are in absolute terms, that is mismatched framing and you're reading junk science.

## **ACRYLAMIDE**

One of those evil-sounding chemicals that chemophobes worry about, acrylamide is just a molecule formed in a process called the "Maillard reaction," which is responsible for the brown color of cooked foods. Humans have been cooking food far longer than environmentalists have existed, so we've been eating acrylamide for hundreds of thousands of years. It's safe to eat toast.

## **ACUPUNCTURE**

Sticking tiny needles into your face or all over your body is not effective for treating pain or any other health problem. If there are any benefits from acupuncture, they are attributable to the placebo effect.

## **AGE OF EARTH**

Multiple lines of evidence – including astrophysical, geological, and biological – unambiguously confirm that the Earth is approxi-



mately 4.5 billion years old. Any other claim is junk science.

## **AGENT ORANGE**

Agent Orange was an herbicide manufactured at the request of the U.S. government. It was later found to contain the contaminant 2,3,7,8-TCCD, also called “dioxin.” Due to the likely toxicity of this contaminant, it is no longer used, and the herbicide 2,4-D has taken its place<sup>1</sup>. Environmentalists purposefully obscure the important nuances of organic chemistry to scaremonger about pesticides.

## **AIR POLLUTION**

Some studies claim that air pollution causes more than 2 million deaths per year, but these do not occur in America. Smog in Chinese cities is a health threat, as is indoor air pollution that occurs when those in poverty burn wood, coal, or feces to stay warm. Air pollution is not a major problem in the United States, so you can breathe a sigh of relief.

## **ALKALINE DIET**

The “alkaline diet” is premised upon several myths: (1) We eat too much processed food, sugar, and GMOs; (2) Those foods cause our bodies to become “acidic”; (3) Acidic bodies generate cancer; (4) Therefore, cancer can be prevented by eating an alkaline diet<sup>2</sup>. There are no health problems associated with eating processed food or GMOs. Furthermore, the food we eat does not change our blood pH, which our bodies tightly regulate to remain within the range of 7.35 to 7.45.

## **ALTERNATIVE MEDICINE**

Alternative medicine includes everything from

acupuncture and Traditional Chinese Medicine to herbal remedies and homeopathy. If alternative medicine worked it would just be called medicine. Instead, the vast majority of practices that fall under the alternative label lack scientific evidence.

## **ANDREW WAKEFIELD**

Andrew Wakefield is the “doctor” who fooled many into believing vaccines cause autism. He is a dangerous fraud. His medical license has been revoked, and his original “study” was found to be based on fabricated data.

## **ANIMAL RESEARCH**

Animal research is mischaracterized by two different kinds of activists. Environmentalists latch onto any mouse study that supports their beliefs, failing to recognize that mice are not little people and that dose matters. Animal rights’ activists claim that animal research is useless because animals are not good models for human disease. Animal research is an important source of preliminary information, but any findings must be explored with further analysis.

## **ANTIBIOTICS**

In humans, antibiotics are prescribed by doctors when people are sick, but should only be used for bacterial infections. For viral infections (e.g., colds, the flu, some ear infections), antibiotics are useless, though they may be prescribed to prevent secondary (bacterial) infections. In livestock, antibiotics have been used to help them grow bigger, prevent disease, and treat infections. The first no longer occurs in the



U.S. The second and third are legitimate uses, but the FDA requires a prescription from a veterinarian<sup>3</sup>.

## ANTIOXIDANTS AND ANTI-AGING PRODUCTS

Though it is not known why our bodies age, various hypotheses have been proposed. The most popular is the notion that, over time, oxidative stress (a byproduct of metabolism) damages the body's cells. In theory, antioxidants should help prevent that, but clinical trials have failed. The best way to "stay young" is through proper nutrition and exercise and to be genetically lucky. Most products are probably scams.

## ARSENIC

Arsenic is one of the elements on the periodic table, but it's not one of the nice ones like neon. It comes in two forms, organic (i.e., bound to carbon atoms) and inorganic (i.e., salts). The latter is much more toxic than the former, but few Americans consume enough arsenic to have any health effects. Your rice and apple juice are safe.

## ARTIFICIAL SWEETENERS

Artificial sweeteners (such as aspartame, saccharin, stevia, and sucralose) are low-calorie sugar substitutes and safe for consumption<sup>4</sup>. There is no evidence that they pose any health threat.

## ASTROLOGY

The location of Jupiter, the phase of the moon, and the curious retrograde motion of Mercury do not affect your life... unless you're an *astronomer*.



## **ATRAZINE**

Atrazine is an herbicide that environmentalists claim causes cancer. (Is there anything they don't blame for causing cancer?) The scientific consensus disagrees, and so does the EPA<sup>5</sup>.

## **AUTISM**

Vaccines, GMOs, and "refrigerator mothers" (mom did not hug you enough) do not cause autism. Genetics is the most likely explanation.

## **BIOFUELS**

Biofuels are a mixed bag. Converting perfectly good corn into ethanol is a gigantic waste of food, energy, and money, and therefore junk science. Using synthetic biology to engineer microbes to produce fuel is a promising area of research.

## **BODY MASS INDEX (BMI)**

Body mass index (BMI) is widely used as a rough estimate of body fat. However, because it cannot discriminate lighter body fat from heavier muscle, it is less useful for individuals but does have value for tracking the "fatness" of populations over time.

## **BPA (BISPHENOL A)**

BPA has been used since the 1950s to prevent food from spoiling. Environmentalists insist it is a health concern due to "endocrine disruption," but the molecule binds poorly to cell receptors compared to actual hormones like estrogen, about 1/20,000<sup>th</sup> as well. The FDA has found no safety issue.

## **BRAIN IMAGING (FMRI)**

Many neuroscience and psychology studies are based

on the use of functional magnetic resonance imaging (fMRI), which allows researchers to detect blood flow in the brain in real-time. In theory, this allows scientists to determine which portions of the brain are “on” or “off” at any given moment. But the technique is flawed. According to one analysis, the statistical software used to analyze the data produces a false positive rate possibly as high as 70%, potentially casting doubt upon thousands of fMRI studies<sup>6</sup>.



## **BRAIN TRAINING GAMES**

Brain training games may be fun, but there is no convincing evidence that they make people smarter. Any perceived benefits are likely due to the placebo effect<sup>7</sup>.

## **BREASTFEEDING**

Breastfeeding provides a bonding experience, and breast milk contains nutrients and antibodies. However, if a mother is unable or unwilling to breast-feed, formula is perfectly safe and healthy. Much to the disappointment of lactation activists (“lactivists”), there is nothing magical about breast milk.

## **BT TOXIN**

Organic farmers spray a toxin on plants derived from the bacterium *Bacillus thuringiensis* (Bt toxin) that kills specific insect pests. Modern biotechnology allows it to be grown inside the plant itself. Ei-

ther way, it is completely safe for human consumption. GMOs that incorporate Bt toxin have helped in greatly reducing the use of applied insecticides.

## **CANCER CLUSTERS**

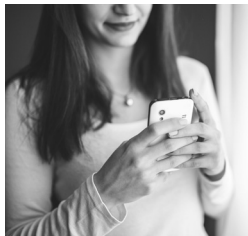
A map depicting cases of a particular disease will often show “clusters” occurring in certain locations. This is usually random chance, but some people conclude that a pattern has developed and some nefarious cause must explain it. A famous example is when Erin Brockovich claimed that hexavalent chromium in drinking water caused cancer and other diseases in a small California town. Follow-up analyses proved her wrong, but not before the legal team she worked for got a settlement from Pacific Gas & Electric for \$333 million<sup>8</sup>.

## **CARCINOGENS**

Judging by environmentalists and sensationalist media, you are very lucky that you haven’t caught cancer (yet) from coffee, toast, bacon, or even that new car smell. Because many are natural, carcinogens are everywhere. Coffee, for example, has dozens of carcinogens but they are present in very tiny amounts. The dose makes the poison.

## **CELL PHONES**

Cell phones are safe. The NIH’s National Cancer Institute cites studies – totaling over one million participants – that convincingly conclude that cell phones are not linked to cancer<sup>9</sup>.



## **CENTER FOR SCIENCE IN THE PUBLIC INTEREST (CSPI)**

Center for Science in the Public Interest (CSPI) is a sue-and-settle organization with a budget of \$17 million<sup>10</sup>. They make specious health accusations, sue high-profile targets, and settle for a large sum of money. They're professional shake-down artists who lie about the alleged dangers of everyday foods and the safety of conventional agriculture, while touting the supposed benefits of organic food.

## **CHELATION THERAPY**

Chelators are molecules that latch onto and isolate metal ions. A person who is suffering from heavy metal poisoning requires chelation therapy. However, chelation therapy has also been used by people who think autism is caused by vaccines. Vaccines do not contain mercury ions, and they do not cause autism. Using chelation therapy to "treat" autism is dangerous junk science.

## **CHEMICALS**

Everything is a chemical. Literally everything: the air you breathe, the water you drink, this book you're holding in your hand. Nothing is "chemical-free." In popular culture, the word "chemical" is often used by activists who are ignorant of chemistry and toxicology to scare the public about their food and the environment.

## **CHIROPRACTIC**

If you feel the need to pay somebody a large sum of money to touch you, try a massage therapist. It will probably feel good and is much less likely to harm you.

## CHOLESTEROL

Cholesterol is a member of the family of chemicals known as steroids. Because the human liver produces cholesterol, a person's blood cholesterol level is primarily based on genetics. In a minority of people, blood cholesterol is influenced by diet. Lowering the level of "bad" (LDL) cholesterol in your blood may decrease the likelihood of cardiovascular disease.

## CIRCUMCISION

Anti-circumcision activists refer to the practice as "genital mutilation." That is nonsense. Evidence shows that in locations where sexually transmitted infections are a major problem, such as Africa, circumcision can help reduce the spread of HIV, HPV, and possibly more diseases<sup>11</sup>. In developed countries, the benefits of circumcision are less clear. Parents should not feel pressured one way or the other.

## COFFEE

Coffee is probably the most studied beverage on the planet. Ironically, though it contains tiny amounts of many carcinogens, there appear to be some health benefits of drinking it. Always remember that "the dose makes the poison." So, enjoy a daily cup of joe or two. Just not 7,000.



## **COLD FUSION**

A perennial favorite of sci-fi enthusiasts and scam artists, cold fusion is junk science. Fusion (which powers the sun) is real, but it is incredibly impractical for scientists to recreate on Earth, because it's what makes the sun so hot.

## **COLDS**

Colds are caused by various types of viruses. That's why there is no vaccine to prevent them. Though it is widely believed that vitamin C can cure or lessen the severity of a cold, that is not true. Perhaps regular vitamin C supplementation reduces the duration of colds<sup>12</sup>. But popping a few vitamin C tablets once you're sick won't help.

## **COLON CLEANSING (COLON HYDROTHERAPY)**

Liquids go in your mouth, not in your butt. Unless you're constipated, there is no reason to give yourself an enema. Your body naturally detoxifies itself.

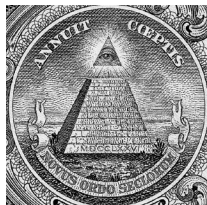
## **CONSENSUS**

Despite politicians and political pundits bizarrely claiming, "There is no consensus in science," there is. Consensus is found in the pages of the scientific literature, usually in the form of literature reviews, meta-analyses, and textbooks. If enough evidence contradicts the current consensus, a new consensus will replace it. Gravity is a consensus. Deny it at your own risk.

## **CONSPIRACY THEORIES**

Nobody likes to self-identify as a "conspiracy theorist," but the truth is that half of all Americans subscribe to at least one<sup>13</sup>. Fairly straightforward mathe-

matics shows that conspiracies are nearly impossible to pull off<sup>14</sup>. That's one reason why conspiracy theories, such as the FDA and Big Pharma colluding to suppress a cure for cancer, are so absurd<sup>15</sup>.



## CONVERSION THERAPY

The Department of Health and Human Service's Substance Abuse and Mental Health Services Administration (SAMHSA) concluded that conversion therapy (i.e., attempting to change a person's sexual orientation) is not based on evidence and may be harmful<sup>16</sup>.

## CORRELATION AND CAUSATION

It is often said that correlation does not mean causation, which is absolutely true, but correlation certainly *implies* causation. That's why correlations are so interesting. But a correlation is simply not good enough. In medicine, a list of criteria created by Bradford Hill (Hill's criteria of causation) guides researchers who are investigating the causes of disease<sup>17</sup>. Before fearmongering about another scary chemical, the rational person will ask if Hill's criteria of causation have been met.

## CRISPR

CRISPR/Cas9 is the latest innovation in genetic modification. It is faster, easier, and even more precise than previous techniques. CRISPR is a revolutionary advance in molecular biology that will have a multitude of applications from agriculture to medicine. Activists, of course, are opposed to it.



## **CRYOTHERAPY**

Athletes often take a dip in an ice bath to aid recovery after a tough game or workout, but there appears to be little to no scientific evidence to justify this<sup>18</sup>. Similarly, you should not stand naked in a cylinder of extremely cold air, just because celebrities are doing it<sup>19</sup>.

## **DATA DREDGING**

Data dredging, also known as p-hacking, is the practice of examining thousands of different variables to determine if one of them is linked to a bad health outcome. This is deeply problematic because, by sheer chance alone, some of the variables will produce false positive results. This is a common strategy for desperate researchers to get papers published, and it is partially to blame for the current reproducibility crisis in biomedical science and psychology.

## **DDT**

DDT has enriched environmentalists all over the world even though its acute toxicity is incredibly low. How low? It's less toxic than aspirin and caffeine. It does accumulate in the body, as does its primary metabolite, DDE. Still, DDT is not carcinogenic, and workers who were heavily exposed never had more cancer than unexposed workers<sup>20</sup>.

## **DEATH (CAUSES OF)**

We are blessed to be alive in the 21<sup>st</sup> Century. Barely over 100 years ago, Americans still died of things like diarrhea and diphtheria<sup>21</sup>. But thanks to the triumphs of medicine, public health, and biotechnology, we mostly die from "lifestyle" or chronic disease, not infections<sup>22</sup>.

	1900	Today
#1	Influenza and pneumonia	Heart disease
#2	Tuberculosis	Cancer
#3	Diarrhea/enteritis	Chronic lower respiratory diseases
#4	Heart disease	Accidents
#5	Strokes	Strokes
#6	Nephritis	Alzheimer's
#7	Accidents	Diabetes
#8	Cancer	Influenza and pneumonia
#9	Senility	Nephritis
#10	Diphtheria	Suicide

## DETOXING

Every day, we consume toxic substances. Most are naturally found in our environment. Rice contains arsenic, seafood has methylmercury, and our bodies produce toxic substances as a normal part of metabolism. But there is good news! Your body is perfectly capable of handling toxins. There is no need to “detox” or “cleanse” because your liver and kidneys have the job covered.

## DIETING

There is one sure way to lose weight. Consume fewer calories than you burn. That is all.

## “DOSE MAKES THE POISON”

In a large enough dose, *anything* can be toxic, noted Paracelsus. If you drink too much water, your

electrolytes will be diluted, and you can die of hyponatremia. Too much oxygen (hyperoxia) can damage your lungs. Keep this in mind when environmentalists or food activists warn about “toxins.” The same substance can be both beneficial and harmful; the difference is the dose.

### **DR. OZ (MEHMET OZ)**

Dr. Oz, the self-appointed “America’s Doctor,” peddles alternative medicine and bogus weight loss miracles. In a public rebuke, his colleagues cited an analysis that concluded that “less than half of the recommendations on his show are based on at least somewhat believable evidence.” They added that his “unsubstantiated medicine sullies the reputation of Columbia University and undermines the trust that is essential to physician-patient relationships.”<sup>23</sup>

### **DSM-5**

The fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* is considered the “Bible of Psychiatry” by its proponents. It can be useful, but it also contains a lot of nonsense and the National Institute of Mental Health considers it simply a glossary.<sup>24</sup> Our culture has pathologized quirky, but normal, behavior. Many normal people could be considered mentally ill based on the DSM-5.

### **E-CIGARETTES**

E-cigarettes are a good way for smokers who are having trouble quitting to wean themselves off cigarettes. It violates both science and common



sense to consider e-cigarettes to be as dangerous as actual cigarettes. However, because inhaling anything other than oxygen into your lungs is a bad idea, people who currently do not smoke should not start.

## **EAR CANDLING**

Ear candling involves sticking a candle into your ear and lighting it on fire. Don't do that. In fact, don't stick anything into your ears. Your body produces earwax for a reason, and it should be left alone unless you have trouble hearing because of a build-up. Then ask a doctor to remove it.

## **EARTHING**

Earthing is the belief that running around barefoot somehow connects you to Earth's energy, which will improve your health<sup>25</sup>. The exact opposite is true. We invented shoes because it protects our feet from injury and infection. Tell the neighborhood hippies to put their sandals back on.

## **ELECTROMAGNETIC HYPERSENSITIVITY**

A tiny number of people claim that electromagnetic fields (like Wi-Fi) make them sick. They don't. A study in *Bioelectromagnetics* found that people cannot tell the difference when an electromagnetic field is turned on or off<sup>26</sup>. The sort of electromagnetic fields that we encounter in everyday life can neither cure nor harm you. Any "illness" caused by electromagnetic fields is completely due to the Nocebo Effect.

## **ENDOCRINE DISRUPTOR**

"Endocrine disruptor" is a term applied to any

chemical that can bind to hormone receptors. There are a lot of those. It is claimed that they may operate through “hormesis,” the idea that tiny doses of a chemical can affect the body, while larger doses have no effect. If endocrine disruption is real, then soy and marijuana should raise just as much concern as chemicals like BPA, but environmental activists aren’t bothered by them<sup>27</sup>.

## **ENVIRONMENTAL WORKING GROUP (EWG)**

The Environmental Working Group (EWG) has a \$12-million budget to scare people about their food<sup>28</sup>. EWG releases an annual “Dirty Dozen” list, in which it accuses healthy foods like strawberries and spinach of secretly poisoning people because of pesticides. The organization is vehemently anti-farming.

## **ENVIRONMENTALISM**

Environmentalism has morphed from a legitimate concern for the welfare of the planet into a science-free religion. Ironically, many policies favored by environmentalists (e.g., the rejection of GMOs and nuclear power) actually damage the environment.

## **EPIGENETICS**

Epigenetics, which involves changes in DNA without changing the actual DNA sequence, is the sexy new field in biomedical science that has been used for very unsexy things, like inventing vague causes for everything from cancer to obesity. While epigenetics plays a role in gene expression and possibly short-term adaptation, there is no reason to

believe that epigenetic mechanisms play any role in long-term evolutionary processes (at least in mammals, anyway)<sup>29</sup>. The field is interesting and important, but beware hype.

## **ESSENTIAL OILS**

Essential oils acquired their name because they contain the “essence” of the plant from which they are derived, not because they are essential to human nutrition. Like many plant extracts, essential oils may contain useful compounds, such as natural food preservatives and antimicrobials<sup>30</sup>. Depending on the plant, they also might smell nice. Beware (essential?) snake oil salesmen offering it as a cure for anything.

## **EVOLUTIONARY PSYCHOLOGY**

The primary theme of evolutionary psychology is that everything humans do is driven ultimately by sex and survival. Why do men hunt and buy sports cars? To get mates. Why do women wear lipstick? To get mates. Why do people donate to charity? To signal how much money they have... so they can get mates. See a pattern? The field reeks of “just-so” stories that can’t be verified by empirical investigation.

## **EXPIRATION DATES**

Many foods and medicines come with “Use by,” “Best by,” or some other expiration date. A lot of these dates are arbitrary. A box of crackers may be a little stale past its expiration date but still safe. The same is true of many medicines, though some really do expire by losing their effectiveness. A few

can become toxic. Be sure to ask your doctor if you want to use old pills.

## **FAD DIETS**

To lose weight, consume fewer calories than you burn. Giving up particular types of food (e.g., sugar or meat) makes no difference. There is no miracle diet.

## **FAKE NEWS**

Fake news is the scourge of the Information Age. As the saying goes, lies can spread around the planet before the Truth gets its shoes on. Fake news is fueled by social media leveraging a culture that has become hyper-partisan, uncivil, and tribal<sup>31</sup>. We have provided tips to detect fake news on our website, ACSH<sup>32</sup>.

## **FALSE EQUIVALENCE**

“False equivalence” is a fake fallacy used by people who never took a logic class because it sounds like a real one. It is popular with political pundits and internet commenters who try to give their double standards and hypocritical arguments a veneer of intellectualism.

## **FLAME RETARDANTS**

Because furniture contains them, flame retardants (like polybrominated diphenyl ethers, PBDEs) can be detected in pretty much everybody, which is why environmentalists can scare people about them. The benefits of preventing explosive fires greatly outweigh any risks, which so far are still zero.

## **FLAMING TAP WATER**

The infamous “documentary” that showed a man’s tap water catching fire was a lie; yes, the water really did catch on fire, but the methane in the water was due to natural seepage. It was not caused by natural gas hydraulic fracturing - fracking.

## **FLUORIDATION**

Following a massively successful water fluoridation project to improve dental hygiene in Grand Rapids, Michigan in 1945, cities all over the country followed suit. Fluoride is good for your teeth and, contrary to claims in some junk science circles, does not result in mind control.

## **FODMAPS**

FODMAPs (Fermentable Oligosaccharides, Disaccharides, Monosaccharides, And Polyols) are sugars and carbohydrates that are poorly absorbed by our digestive systems. Bacteria, however, love them – and can convert them into gases which make some people feel bloated and terrible. People with irritable bowel syndrome (or those who think they are “gluten sensitive”) may benefit from a low FODMAP diet<sup>33</sup>.

## **FOOD ADDITIVES**

Anything that is added to our food must be approved (either expressly or tacitly) by the FDA. Food colors or dyes and preservatives are perfectly safe.

## **FOOD BABE**

Vani Hari, a.k.a., “Food Babe,” skyrocketed to fame by shrieking about all the scary “chemicals”



that are in our food. She says if she cannot pronounce the name of a chemical, you shouldn't consume it. (That rules out dihydrogen monoxide.) She also promotes (and receives commissions from) products that have the very same chemicals she warned her readers not to eat<sup>34</sup>.

## **FOOD IRRADIATION**

Since 1999, the US has used this safe deterrent for foodborne illness. 60 countries world-wide also now do as well. Irradiating more of our food would kill pathogens, like *E. coli* and *Salmonella*, and would reduce the 48 million foodborne illnesses that the CDC estimates to occur each year<sup>35</sup>. Food irradiation does not change the nutritional value of food, nor will it make your food radioactive<sup>36</sup>.

## **FOOD LABELING**

Food labels contain important dietary information, such as calorie and nutritional content. They should not contain political propaganda, such as warnings about GMOs based on junk science.

## **FOOD PRESERVATIVES**

Processed food often contains preservatives, which maintain freshness, increase shelf-life, prevent foodborne illness, and reduce food waste. Preservatives are safe, and many come from natural sources, particularly fruits<sup>37</sup>. For unknown reasons, BHT (found in algae but produced commercially) and BHA (a synthetic compound) scare people, but they shouldn't.

## **FORENSICS**

Forensics is vital to the criminal justice system, but

it provides nowhere near the rock solid evidence that is commonly portrayed in TV crime dramas. According to the Innocence Project, shoddy forensic science is the second most common contributor to wrongful convictions<sup>38</sup>.

## FORMALDEHYDE

Formaldehyde is found everywhere, even in fruits and vegetables. Our bodies produce it during amino acid metabolism. But since it is used as embalming fluid, environmentalists have tried to create scares about trace amounts of formaldehyde in clothing or food.

## FRACKING

Natural gas extraction using hydraulic fracturing (“fracking”) has caused U.S. carbon dioxide emissions from energy to plummet. But environmentalists who embraced natural gas for decades turned on it, claiming that fracking causes earthquakes and pollutes water. Neither is true. Wastewater injections near fault lines may trigger small earthquakes, not fracking itself. And fracking occurs *below* the water table. Unless gravity stops working, the water table can’t be contaminated. An infamous “documentary” showing tap water catching fire was due to natural methane seepage, not fracking.



## **FREEDOM OF INFORMATION ACT (FOIA) ABUSE**

The Freedom of Information Act (FOIA) was a law passed with the intention of preventing corruption by government officials. Anti-science activists, however, have abused the law to harass law-abiding academic scientists. The tactic involves requesting years' worth of emails, taking comments out of context, then smearing the reputation of scientists online. It should be seen as a form of cyberbullying.

## **FUKUSHIMA-DAIICHI**

The meltdown of Japan's Fukushima-Daiichi nuclear power plant is used as fodder by anti-nuclear activists. However, modern nuclear power plants have been redesigned to be meltdown-proof. Fear and panic were far worse for the health of Japanese people than exposure to radiation, which was quite low. A radiation expert observed, "There have been more than 80 suicides linked to the accident and the evacuation. But there have been no deaths or sickness from direct exposure to radiation."<sup>39</sup>

## **GENETIC ANCESTRY**

Genetic ancestry tests use a small dash of science and a heaping scoop of speculation. Though your DNA contains information about your biogeographic ancestry, some commercial genetic ancestry tests may be little more than horoscopes<sup>40</sup>. If you want to predict whether you will like cilantro or not, they are fine.<sup>41</sup>

## **GENOME-WIDE ASSOCIATION STUDIES**

The goal of genome-wide association studies is

usually to identify genetic markers (e.g., mutations) that are linked to diseases. This is perfectly legitimate research, but it is often hyped in the popular media. Findings are usually reported as, “Scientists have discovered a gene that causes depression.” In reality, scientists probably found a particular version of a gene that might contribute to 1% or fewer cases of depression. The data are rarely as exciting as portrayed in the news.

## **GEOMAGNETIC REVERSAL**

Much to the dismay of doomsday prophets, Earth is still here, despite annual proclamations of demise due to various causes. One such worry is the reversal of Earth’s magnetic poles. Yes, they can flip, as they have done many times in Earth’s past. It’s a perfectly natural phenomenon, but it occurs slowly over the course of thousands of years<sup>42</sup>. Apocalypse watchers can worry about something else in the meantime, like Y3K.

## **GERMS**

“Germs” is a term used mostly by overprotective parents and peddlers of worthless health products. Bacteria and viruses are everywhere: Your skin, doorknobs, even the very air you breathe. Our bodies are equipped with ruthlessly efficient immune systems that handle these everyday assaults. Ironically, our obsession with being clean may actually be making us sick: The “hygiene hypothesis” suggests that our overly clean society is responsible for the rise in allergies and asthma.

## **GILLES-ÉRIC SÉRALINI**

A hero of the anti-GMO movement, Gilles-Éric Séralini famously conducted an unethical animal experiment in which he grew giant tumors on rats and then blamed GMOs and the herbicide glyphosate. His methods were severely flawed, and his claims are consistently in defiance of the scientific literature.

## **GLUTEN**

Very few people have problems metabolizing gluten. A tiny percentage of people are allergic to it, and another tiny percentage have Celiac disease. Though some people might have non-Celiac gluten sensitivity, gluten-free diets are a fad. People who report improved health after going gluten-free probably feel better due to eliminating excess carbohydrates from their diets, such as FODMAPs.

## **GLYPHOSATE**

Popularly known as “RoundUp,” glyphosate is an herbicide associated with Monsanto, though it has been off-patent since 2000 and at least 40% of the world’s glyphosate comes from Chinese companies<sup>43</sup>. All legitimate scientific regulatory bodies dismiss activist claims that glyphosate causes cancer, even the notoriously risk averse European ones<sup>44</sup>. Similar to antibiotics, the only problem with glyphosate is that there has been an increase in glyphosate-resistant weeds.

## **GMOS**

Genetically modified organisms represent one of the biggest advances in the history of science. (Pro

tip: Scientists don't use the term GMOs because that is a legal term; instead, they call them "transgenic crops.") With surgical precision, molecular biologists place unique genes into a plant's genome, conferring new properties that hybridizing could never achieve. It has allowed the creation of insect-resistant crops (which require fewer insecticides), fast-growing salmon (that will reduce overfishing), non-browning apples, and rice that provides extra vitamin A to malnourished people. Everyone who cares about feeding people with the smallest possible environmental footprint embraces this technology.

## **GREENPEACE**

Despite its name, Greenpeace is neither "green" nor "peaceful." Its opposition to nuclear power, hydroelectric power, and GMOs has damaged the planet. Its vandalism of the Nazca Lines, a UNESCO World Heritage site, proves that the organization cares little for humanity. With a combined budget of \$53 million, Greenpeace USA and Greenpeace Fund undermine scientific consensus and technological progress<sup>45</sup>.

## **GROWTH HORMONES (RBST)**

Some cartons of milk contain the label "rBST-free," which means that cows were not injected with a hormone called recombinant bovine somatotropin that causes them to produce more milk. Because you're not a cow, the hormone does not affect you.

## **HEALTH BRACELETS**

Certain bracelets claim to give people who wear

them more energy, greater balance, and a whole host of other amazing health benefits. How does a little rubber band do all of that? It doesn't. It's a complete scam. If a person wearing one feels better, the result is entirely due to the placebo effect.

## **HERBAL REMEDIES**

Herbal remedies are a large part of Traditional Chinese Medicine. Unfortunately, most of them don't work. The ones that do work are now called medicine rather than alternative medicine.

## **HEXAVALENT CHROMIUM**

Anyone who has seen the movie *Erin Brockovich* knows that she and her law firm struck it rich by accusing Pacific Gas & Electric of causing cancer in a small California town due to hexavalent chromium in the drinking water. If inhaled, chromium-6 can cause lung cancer, but there is no reason it causes cancer when ingested. It certainly doesn't cause every disease under the sun, as Erin Brockovich and the legal team asserted<sup>46</sup>.

## **HIGH-FRUCTOSE CORN SYRUP**

Table sugar (sucrose) consists of two sugars linked together: glucose and fructose. As its name implies, high-fructose corn syrup contains more fructose than glucose. But so does honey, which has roughly the same ratio of fructose to glucose<sup>47</sup>.

## **HOMEOPATHY**

Homeopathy is based upon two crazy beliefs: That water molecules can "remember" the presence of other molecules and that extremely dilute solutions of poisons can cure people of various illness-

es. Chemically, the solutions are often so dilute that the original substance is no longer present. Homeopathic products are a scam.

## **HORMESIS**

A saying goes that what doesn't kill us makes us stronger. There is evidence to suggest that our bodies, when exposed to minor assaults (e.g., a low dose of radiation), become slightly stronger and more resilient. This is known as hormesis. A low dose of a "dangerous" substance may be okay, but a high dose is bad. This has been flipped by those who claim that low concentrations of environmental pollutants are bad, while high doses are safe. Treat such research with skepticism, especially if coupled with talk of endocrine disruptors.

## **HORMONE REPLACEMENT THERAPY**

Hormone replacement therapy (HRT) involves the replacement of estrogen and progesterone in women who are post-menopausal, either due to aging or ovary removal. It was once recommended for most menopausal women but is now recommended only for women with severe menopausal symptoms. For men, there is little reason to believe that testosterone supplementation is worthwhile. The "low T" advertising campaign rests on very shaky assumptions. Extra testosterone may instead cause health problems.

## **INTELLIGENT DESIGN (ID)**

Critics of Intelligent Design often conflate it with Young Earth Creationism, but ID proponents often accept evolution and an ancient Earth. They claim



that “irreducibly complex” molecular structures provide evidence for an Intelligent Designer. The trouble with this argument is that evolution can explain structures that appear irreducibly complex. Science cannot be used to prove the existence (or absence) of God.

## **INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)**

The International Agency for Research on Cancer (IARC) was created to identify possible carcinogens for further study, studies that would include risk. Today, IARC spends its time blaming perfectly normal things – like hot water and bacon – for causing cancer. Any proclamation made by IARC is now met with serious skepticism.

## **KETOGENIC DIET**

Any diet that is very low in carbohydrates will be ketogenic, which means the body will produce molecules called ketone bodies as it burns fat. The initial weight loss can be substantial but is mostly water. Other than bad breath and lack of endurance in sports, ketogenic diets aren’t unhealthy, unless ketone levels are so high that a person’s blood pH drops, a potentially dangerous condition called acidosis, which also occurs in type 1 diabetics who don’t get insulin.

## **LEAD (AND THE FLINT WATER CRISIS)**

Lead is an element on the periodic table, and it is toxic to humans. Environmental contamination has decreased considerably since we banned lead from gasoline and paint. The contamination of

Flint, Michigan's water supply with lead was a serious public health breach, but the national reaction was hyperbolic. Children everywhere, including in Flint, have lower blood levels of lead than either their parents' or grandparents' generation<sup>48</sup>.

## **MARIJUANA**

Though smoking marijuana is probably safer than smoking cigarettes, inhaling anything into your lungs other than oxygen is not a good idea and will almost certainly have long-term health consequences. Medical marijuana could be beneficial in treating pain and reducing opioid use but due to its classification it has not been studied enough to make that determination.

## **MERCOLA**

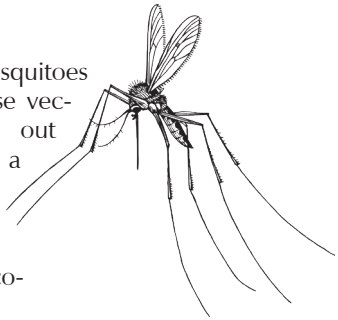
Joe Mercola, D.O., is an osteopath notable for being one of the largest purveyors of junk science and quackery on the Internet. Avoid his recommendations.

## **MONOSODIUM GLUTAMATE**

There's a good chance that your favorite Chinese restaurant has a sign somewhere that says, "No added MSG." MSG stands for monosodium glutamate, the sodium salt of glutamate, an amino acid that is naturally found in many different foods. The reason MSG is added to food is because it enhances flavor (specifically, umami). MSG is perfectly safe to eat – because it's already in your food – but activist hysteria over MSG remains one of those bizarre moments in culinary history. There are no health effects due to it.

## MOSQUITOES

Some species of mosquitoes are nothing but disease vectors. Wiping them out would make the world a much healthier, safer place, despite junk science claims about ripple effects in the ecosystem.



## MUTATIONS

A misused term by junk science promoters, “mutation” is any change in DNA sequence, be it beneficial, neutral, or harmful. At one time, “mutation breeding” was a common technique in which a radioactive material was used to introduce mutations into plants to create useful new traits. This technique produced fungus-resistant peppermint and improved many other crops, such as rice and wheat<sup>49</sup>.

## NATIONAL CENTER FOR COMPLEMENTARY AND INTEGRATIVE HEALTH (NCCIH)

If the *X-Files* was about medicine rather than aliens, Mulder and Scully’s office would be located at the National Center for Complementary and Integrative Health (NCCIH), formerly known as the National Center for Complementary and Alternative Medicine (NCCAM). This junk science agency wastes about \$130 million every year studying things like yoga and chamomile<sup>50</sup>.

## **NATURAL GAS**

Though environmentalists once embraced natural gas as a bridge to a carbon-free future, today they are opposed to it on purely ideological grounds. Natural gas has reduced pollution and kept energy cheap, regardless of the fact-free claims made by modern activists.

## **“NATURAL IS BETTER”**

The widespread myth that “natural is better” underlies everything from alternative medicine to the organic food movement. It’s the poster child for junk science. Smallpox, HIV, arsenic, poison ivy, rattlesnakes, and scorpions are all natural, while many beneficial medicines are not.

## **NATURAL NEWS**

Mike Adams, purveyor of the conspiracy website Natural News, compares vaccines to Syrian chemical weapons<sup>51</sup> and once encouraged his followers to kill anybody who supports GMOs<sup>52</sup>.

## **NATURAL RESOURCES DEFENSE COUNCIL (NRDC)**

Natural Resources Defense Council (NRDC) uses an authoritative sounding name and a \$133-million budget to undermine scientific consensus and technology<sup>53</sup>. They routinely fearmonger about “chemicals,” particularly pesticides. Like most environmentalist organizations, they blindly endorse organic food, even though science does not support organic over conventional agriculture.

## **NATUROPATHY**

Naturopaths are the High Priests of alternative medicine. They wholeheartedly reject Western medicine and modern science. At its best, a natu-

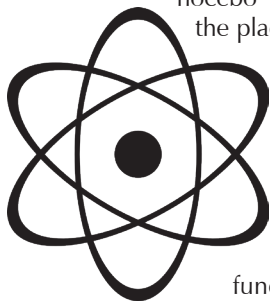
ropathic “remedy” does nothing (except perhaps trigger a placebo effect). At its worst, naturopathic remedies can kill you.

## **NICOTINE**

Like caffeine, nicotine is made by plants as an insecticide. In humans, the molecule can be addictive, which is why smokers have such a hard time quitting cigarettes. By itself, nicotine may be no more dangerous than caffeine. Ignore junk science claims that nicotine replacement solutions (e.g., e-cigarettes) are a gateway to smoking.

## **NOCEBO EFFECT**

Imagine participating in a study, and you are told that the pill you take will make you woozy. A few minutes later, you are feeling a bit woozy, but then you find out you just took a sugar pill. Your “side effects” were completely psychosomatic because you expected them to occur. Such is the power of the nocebo effect. It explains why some people claim that Wi-Fi makes them sick. Essentially, the nocebo effect is the opposite of the placebo effect.



## **NUCLEAR POWER**

Nuclear power is clean and efficient, albeit expensive due to government regulations. Generation IV nuclear power plants have been fundamentally reengineered to be meltdown-proof. China is

building the world's first<sup>54</sup>. Anti-nuclear activists claim waste is an unsolvable problem, but that's untrue. France recycles some waste from nuclear power plants, and other waste can be stored safely for millennia. Decades of study showed Yucca Mountain in Nevada was the ideal waste storage facility, but political interests shut it down.

## **NUTRITION**

Far too much of what passes for nutrition research is conducted using surveys, which are notoriously unreliable. Edward Archer, a computational physiologist, found that volunteers' self-reported energy intake was physiologically implausible<sup>55</sup>. Even worse, the field is plagued by food activists and shady peddlers of fad diets or "miracle cures." Trustworthy nutritional information is incredibly difficult to find, as many experts want to sell their diet books.

## **OBESITY**

Junk science claims that specific foods cause obesity, and the problem can be solved through bans and taxes. The reality is people eat too much and don't exercise. If the number of calories you consume is less than the number of calories you burn, you will lose weight. It's not food magic; it's physics.

## **OPIOIDS**

The ongoing opioid epidemic is complex. Prescriptions for a small amount of opioids, like Vicodin or OxyContin, rarely lead to addiction. The major culprit is likely to be recreational users, such as drug addicts who turn to heroin when pills are unavailable<sup>56</sup>. Heroin is more dangerous when adul-

**NO**

terated with fentanyl, a compound 50 times more potent than morphine.

## **ORGANIC FOOD**

Organic food is a gigantic scam. Despite marketing claims, \$12 bananas aren't healthier, tastier, more nutritious, or better for the environment. Organic farmers also use pesticides, though they are quite content letting the public believe otherwise. Because organic farming is inefficient, we could not feed the world using it alone<sup>57</sup>.

## **OSTEOPATHY**

In the United States, osteopaths are nearly identical to medical doctors, but in other parts of the world, they are basically chiropractors<sup>58</sup>. If an osteopath offers to cure your baby's sniffles by shaking it, find an M.D.

## **OVER-DIAGNOSIS**

Victim status is celebrated in the United States. From campuses to courtrooms, anything bad that happens is somebody else's fault. This culture of victimhood has been enabled by psychology with its latest edition of DSM-5, in which just about any normal (albeit odd) behavior could be categorized as a mental disorder. It is because of this pathologization of everything that we arrive at diagnoses such as "pre-diabetes" and "post-election stress disorder," neither of which are real.

## **OVERPOPULATION**

Since the days of Thomas Malthus, some have worried that the planet is overpopulated. At worst, there is localized overpopulation. The planet has

enough resources for everybody. Besides, population growth is slowing down. Though demographers predict there will be 11 billion people on the planet by 2100<sup>59</sup>, the world population likely will peak and eventually decline.



## PAUL EHRLICH

Paul Ehrlich is America's foremost doomsday prophet and the "Father of Junk Science." His 1968 book, *The Population Bomb*, predicted mass starvations from overpopulation. Instead, farmers used technology to produce more food on less land. Many people still buy into the false belief that the world is overpopulated.

## PEANUTS

Peanuts cause severe allergies in a small number of people. Junk science claims that smelling or touching peanuts causes anaphylaxis, and therefore peanuts should be banned from schools. In reality, the peanut allergen must be inhaled, ingested, or brought into contact with a body orifice, such as the eyes. Schools that go "peanut-free" do not experience a reduction in anaphylaxis, though "peanut-free" lunch tables do seem to work<sup>60</sup>. One solution to some peanut allergies has been earlier introduction in kids, but consult with your doctor.



P



## **PEOPLE FOR THE ETHICAL TREATMENT OF ANIMALS (PETA)**

Treating animals humanely and ethically is a topic important not only to the public but to scientists, as well. That's why it's such a shame that it's been turned into junk science by PETA, who once criticized the world-famous fishmongers at Seattle's Pike Place Market for tossing dead fish, which they said is akin to tossing dead kittens<sup>61</sup>. Animal welfare is a serious issue, but PETA is not a serious organization to address it.

## **PESTICIDES**

Thanks to environmentalists, the public fears pesticides. The organic industry has successfully fooled people into thinking that their farmers don't use pesticides, but they do. All pesticides currently in use – both synthetic and natural – are safe if applied at approved levels. You should wash produce before eating it. Not because of pesticides, but because of bacteria. Pesticides don't do a thing about that.

## **PHARMACEUTICAL INDUSTRY (BIG PHARMA)**

Big Pharma has produced medicines and vaccines that have saved literally hundreds of millions of lives. They have also conducted ethically outrageous clinical trials, gouged patients on drug prices, downplayed dangerous side effects, and manipulated the scientific literature. Demeaning an entire industry due to the actions of a few players throughout history is not constructive. In modern times, generic companies have had similar pricing and ethical issues.

## **PHTHALATES**

In use for nearly 100 years, phthalates are necessary to make tubing flexible. Epidemiological studies of possible adverse effects of phthalates have been contradictory while toxicology reports show no risk because animal doses were thousands of times higher than possible human exposure. Ignore the chemophobic hype.

## **PIPELINES**

Pipelines are the safest way to transport fossil fuels. Compared to rail, pipelines are roughly 4.5 times safer<sup>62</sup>. Opposition to pipelines is based solely on ideological opposition to fossil fuels.

## **PLACEBO EFFECT**

Imagine you are in a clinical trial for a pill that will make you feel stronger, smarter, and more energetic. It will even increase your libido! After a few days of taking the pill, that's exactly how you feel. A miracle, right? Not if the drug was a sugar pill – a placebo – which is inert. You felt amazing because you expected to feel amazing. This is a well-documented phenomenon called the placebo effect, and it's precisely why new drugs are tested against placebos to see if they actually work. The placebo effect explains why some people claim alternative medicine “works.”

## **PLACENTA**

Some claim that consuming your placenta after birth will ward off post-partum depression. Just because some animals do it (to not attract predators) and some celebrities do it (a mystery, but claims

about hormones and recovery) eat their placentas after giving birth doesn't mean you should. It came into existence in humans as part of the "natural birth" movement in the 1960s. Like fortune cookies, its origin in ancient Chinese culture is a myth.

## **PLASTIC (BAG BANS AND OCEAN POLLUTION)**

Contrary to popular belief, the "garbage patch" of plastic pollution in the ocean has been grossly exaggerated<sup>63</sup>. Yes, there's some plastic and that's a bad thing. But the problem does not stem from plastic bottles and bags, which is why banning them won't work. A bigger problem for the oceans is the prevalence of discarded fishing nets<sup>64</sup>.

## **POLITICIZATION OF SCIENCE**

When science meets politics, the result is often junk science. Neither Left nor Right has a monopoly on scientific disinformation; politicians from both sides of the aisle happily throw science under the bus when it suits their electoral prospects.

## **POLYCHLORINATED BIPHENYLS (PCBS)**

Polychlorinated biphenyls are used as insulators for electric lines. Like DDT and flame retardants, they bioaccumulate. However, they are non-toxic at the levels at which people are typically exposed. The lethal dose is 500,000 times the typical exposure<sup>65</sup>.

## **POST-ELECTION STRESS DISORDER**

Some Americans cannot handle the stress of living in a democracy. For those people, psychologists have invented a fictitious disease: Post-election stress disorder. In reality, they suffer from some immaturity and puerility<sup>66</sup>.

## **POSTMODERNISM**

Dressed up in the language of enlightenment, postmodernism is a form of moral, cultural, and intellectual relativism. As such, it is the ultimate rejection of knowledge. Popular in the humanities, it is anathema to scientific inquiry.<sup>67</sup>

## **PRECAUTIONARY PRINCIPLE**

The precautionary principle is the belief that new technologies should be assumed unsafe unless proven otherwise. It is favored by environmentalists because it is impossible to ever prove anything completely safe. Europe has enshrined the precautionary principle into law, and we should not emulate that.

## **PREDATORY JOURNALS**

There has been a proliferation of “pay-to-play” scientific journals that are complete scams. The research is often terrible, plagiarized, and/or fraudulent. If there is a one-off study that claims to claim a disastrous effect or miracle benefit no one else can find, look at the journal. Beware journals that scientists in the field have never heard of.

## **PREDIABETES**

A slightly elevated blood glucose level now has its own diagnosis: Prediabetes. But is it real? Not at the A1C level the CDC chose. Instead, only about 5% of those who score a 5.8 on a glycohemoglobin test go on to develop diabetes<sup>68</sup>. Using their arbitrary number, the CDC claims 80 million Americans are prediabetic<sup>69</sup>, which creates an unnecessary panic. Their reasoning is dubious<sup>70</sup>.

## PROPOSITION 65

The State of California requires warning signs to be posted in places that might contain carcinogens. The result is gigantic cancer signs being posted in restaurants, Starbucks, airports, parking garages, hospitals, and at Disneyland.

## PSA (PROSTATE-SPECIFIC ANTIGEN) SCREENING

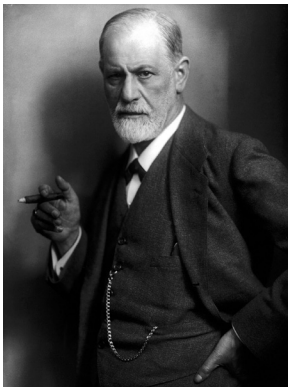
Screening for prostate cancer using a PSA test is controversial. Increasingly, it seems as if the harms (e.g., false positives and overtreatment) outweigh the benefits<sup>71</sup>. Widespread screening for prostate cancer is unlikely to be in the best interest of public health.

## PSYCHICS

Nobody can see the future. Anybody who claims to predict the future is either a psychic or an economist, and both have roughly the same track record.

## PSYCHOLOGY

Psychology is important because we need to know how and why people think, feel, and behave the way they do. Unfortunately, much of what passes for research in psychology is pure garbage<sup>72</sup>. Consider Sigmund Freud, who had a



profound impact on our culture. The trouble is that many of his ideas have never been verified by evidence, and some observers believe he held the field back<sup>73</sup>. Experimental psychology can be scientifically rigorous, but the field as a whole still produces highly dubious research, such as the idea that political beliefs are genetic. Perhaps that is why psychology is facing an enormous replication crisis.

## **PUBLICATION BIAS**

Like newspapers, scientific journals want readers. So, they are biased toward publishing flashy new results and biased against “boring” research, such as negative results or replications. Unfortunately, boring research is often more important and better supported.

## **QUANTUM HEALING**

“Quantum healing” is a term used by phonies like Deepak Chopra that sounds more scientifically authoritative than faith healing and different than Reiki. Unlike Reiki, believers claim this power can be learned. Like Reiki, there is no actual power of any kind. It is just dangerous junk science.

## **QUINOA**

Quinoa – also called “hippie porridge” by ACSH President Hank Campbell – is a “superfood” fad embraced by elites with more money than sense. Like other grains, quinoa is healthy, but there is nothing magical about it. Regardless, Western demand became so high that poor Peruvians and Bolivians could barely afford to buy the grain their

countrymen grew. Imported junk food was cheaper<sup>74</sup>. Luckily for them the free market intervened.

## **R&D FUNDING**

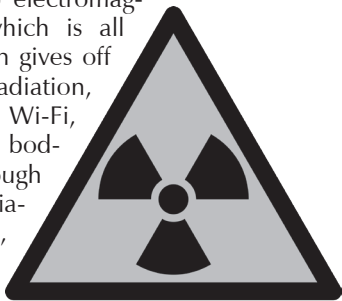
There is a public perception, promoted by politicians, that most research is performed in academia and funded by government. While most basic research occurs there, industry performs the bulk of scientific research and development. In 2016, the U.S. spent \$514 billion on R&D, nearly 2/3 of which was funded by industry<sup>75</sup>. Without industry funding, America could not lead the world in science.

## **RACE**

Race is complex. It is a combination of genetics and culture. Human history can be traced via genetics, and your DNA reveals your biogeographic ancestry. Some genetic diseases are predominantly associated with particular races. Thus, race is not just a “social construct,” regardless of what some sociologists contend<sup>76</sup>.

## **RADIATION AND RADIOACTIVITY**

Radiation refers to electromagnetic radiation, which is all around us. The sun gives off electromagnetic radiation, as do light bulbs, Wi-Fi, and even our own bodies. In large enough doses, some radiation is harmful (e.g., X-rays and UV light), while some



is completely harmless (e.g., visible light and radio waves).

Radioactivity refers to a process in which the nuclei of atoms break down. Depending on the type and dose, radioactivity can be either harmless or harmful. Radioactive elements are present everywhere, including the air (e.g., radon) and our bodies (e.g., carbon-14). These sources of radioactivity are confusingly called “background radiation.” Tiny doses of radioactivity are unlikely to be harmful. People visit Guarapari beach in Brazil because they believe its radiation is helpful.

## **RAW OR UNPASTEURIZED FOOD**

There is no reason to eat raw or unpasteurized dairy, juices, eggs, or meat. We pasteurize and cook our food to kill dangerous microorganisms, some of which can be lethal. Junk science claims that pasteurization removes nutrients. In reality, the only thing pasteurization removes is a larger risk of illness.

## **RECALL BIAS**

If you get diagnosed with a scary or rare disease, you are likely to remember your life differently than people without the disease. This is a well-known phenomenon called recall bias, and it explains why some epidemiological studies are inaccurate. As a general rule, people’s memories are notoriously unreliable.

## **REPRODUCIBILITY (REPLICATION)**

Biomedical science and psychology are facing a reproducibility (replication) crisis, it is said. The results of many studies aren’t being replicated in

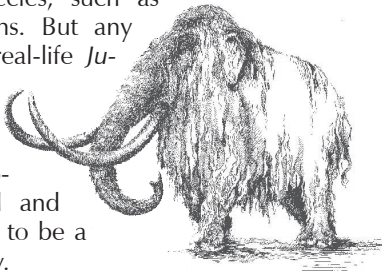


other labs. Reproducing – replicating - an experiment is more complex than it sounds. If you find a drug that may help with a disease, other scientists replicate it but the results may not be exact because of the complexity of organisms. Reproducibility and repeatability are reported as standard deviation. Problems in replication (70%!) has been something of a crisis in biomedicine, due to small sample sizes and publication bias, and in psychology because of shoddy methodology and bizarre hypotheses, but as noted, replication is a on a spectrum, it is not pass-fail.

The real takeaway is “science is hard.”

## **RESURRECTION (“DE-EXTINCTION”)**

Technology likely will allow scientists to “resurrect” extinct species, such as woolly mammoths. But any claims about a real-life *Jurassic Park* are based on junk science, as the DNA from dinosaurs is too old and degraded for this to be a realistic possibility.



**R**

## **RELATIVE RISK**

Humans are fundamentally bad at understanding risk. Unlike Absolute Risk, the important risk is relative – such as your exposure to a hazard. If something is deemed risky, we must ask, “Compared to what?” Many people think GMOs are

dangerous, but don't think twice about getting behind the wheel of a car every day. GMOs have never harmed anyone, but car crashes kill more than 30,000 Americans every year. Yet people still drive to Whole Foods to avoid GMOs. The truth is that common, boring things are much more likely to kill you than exotic hazards.

## **SAMPLE SIZE**

For scientific research to be accurate and statistically meaningful, it needs to have adequately large sample sizes. Many studies, however, fail to meet this requirement. Small sample sizes are one of the reasons why there is a reproducibility crisis in biomedicine and psychology.

## **SCIENCE EDUCATION**

Every so often, people fret that the American education system is failing compared to other countries, based on standardized tests. The proposed solution is always the same: Throw more money at the government, even though we outspend almost every country on K-12 education. America does not teach to the test so where we falter in K-12 tests we make up for in the world's highest adult science literacy, because we teach how to think. Our higher education is the best in the world, and we dominate in scientific output and technological achievement.

## **SCIENCE FUNDING**

"Follow the money!" is a warning sign that junk science claims may follow. While governments, foundations, corporations, and individuals pro-

vide grants to scientific groups whose work they like, instances of pre-determined results based on funding are rare. What matters is not the funding source but the quality of the science. If the science is accurate, then it doesn't matter who paid for it – be it industry, academia, or a nonprofit.

## **SCIENCE JOURNALISM**

Journalism is permeated with political ideologies, half-truths, double standards, and outright fabrications. Science journalists have even more political bias than regular journalism, and they will embrace any weak observational claim. Scary chemicals and miracle vegetables are common. Journalists are how junk science claims get so much traction.

## **SCREENING TESTS**

Junk science claims are that every person should be screened for as many diseases as possible. While detecting a disease early and saving a person's life is fantastic, there is a hidden downside to mass screening. False positives (a person is told they have cancer when they do not) causes psychological trauma as well as large medical bills. Another problem is "lead time bias," which suggests that early detection might just make you aware of your cancer for a longer time but isn't always translating into prolonged survival.

## **SECOND-HAND SMOKE**

Cigarette smoke is many things: Obnoxious, smelly, gross, dangerous. It does not, however, cause cancer if a person is only exposed to it second-hand in restaurants or bars. Chronic exposure

to second-hand smoke, by living with a smoker for instance, may result in other health problems. While smoking bans have made life much more refreshing for non-smokers, the public bans were justified largely on hype<sup>77</sup>. Smoking, however, kills.

## **SEX DIFFERENCES**

Culture seems to be confused about the sexes. Biology has taught us that men and women are different, not just in basic plumbing, but physiologically and psychologically as well. Even our immune systems can differ from each other. Celebrate that diversity.

## **SEX EDUCATION**

Parents want to believe their kids will never have sex, and many teach them to be abstinent until marriage. That is a perfectly good and decent moral upbringing, but the biological urge and cultural temptation of sex may be too difficult for some teenagers and young adults to resist. One study found that nearly 10% of female adolescents who proclaimed abstinence tested positive for semen<sup>78</sup>. And a large review concluded that abstinence-only education did not promote changes in sexual behavior while more comprehensive education did<sup>79</sup>.

## **SILENT SPRING**

Being mindful of the environment and taking measures against polluting it are admirable goals, and Rachel Carson deserves recognition for promoting those. However, her commissioned book *Silent Spring* was an unscientific nightmare, with limited sources and a heavy

reliance on anecdotes. University of Wisconsin agriculture expert Ira Baldwin rebuked it in *Science* magazine as a “prosecuting attorney’s impassioned plea for action.”<sup>80</sup> The hysteria her book caused lives on today in the modern environmentalism movement.

## **SILICONE (BREAST IMPLANTS)**

Many women who received breast implants made from silicone had them removed out of fear that the implants would cause cancer. They do not<sup>81</sup>.

## **SODIUM**

Table salt, colloquially referred to as “sodium,” has been demonized as a major cause of high blood pressure, but the evidence was always slim. Minimum and maximum levels have been created as guidelines due to lawsuits, not science. While reducing sodium intake might be appropriate for some people, it does not appear to be a justifiable public health goal for all<sup>82</sup>.



## **SODIUM LAURYL SULFATE**

Sodium lauryl sulfate (SLS) is a common, safe detergent that has been the target of various “natural” marketing claims. Jessica Alba’s “Honest Company” claimed it was harmful and that they replaced it with “natural ingredients” from coconuts, but it was still SLS<sup>83</sup>. Coconut oil, palm oil and petroleum are all sources of the same synthet-

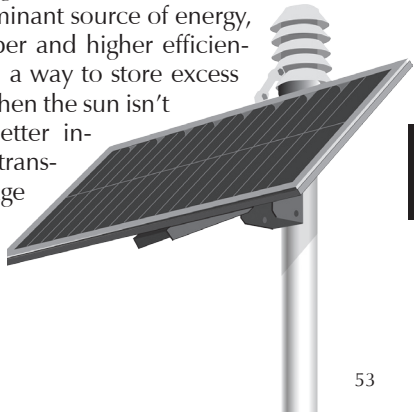
ic detergent. It can be replaced with trans fats in vegetable oil, but SLS is not only safe for skin, it can be eaten.

## **SODIUM NITRATE/NITRITE**

Sodium nitrate and sodium nitrite are added to food as preservatives. Most of the nitrates in our diet (perhaps 85%) come from vegetables, while nitrites come mainly from processed meats, which are added to prevent botulism<sup>84</sup>. Junk science foodies claim nitrates and nitrites cause cancer, but they provide no believable explanation. Both nitrates and nitrites have beneficial health effects, and nitrate/nitrite conversions occur within our bodies.

## **SOLAR POWER**

Solar power isn't really junk science, plants have used it just fine for a billion years, but its most vocal proponents peddle plenty of junk. What's holding solar power back is not a conspiracy by oil companies and politicians but a lack of technological breakthroughs. For solar to become the world's dominant source of energy, we need cheaper and higher efficiency solar panels, a way to store excess power to use when the sun isn't shining, and better infrastructure to transmit high-voltage electricity from sunny places to not-so-sunny places.



## **STATISTICAL SIGNIFICANCE**

Statistical significance is a fancy way to say, “We think these results aren’t due to a random fluke.” In other words, the result is real with a certain degree of confidence. However, just because a result is not a random fluke does not mean it is important or relevant. If a chemical raises your risk of cancer from one in a million to two in a million, it may be statistically significant but it’s irrelevant to your life. A lot of junk science claims result from misuse of statistical significance.

## **STEM CELL THERAPY**

Stem cells retain the ability to grow into various types of tissues. Adult stem cells can only differentiate into a small number of tissues, while embryonic stem cells can grow into any tissue. Though they are likely to play a vital role in regenerative medicine, beware junk science. Many stem cell clinics are dangerous scams run by charlatans. One woman received stem cell injections around her eyes, only to have the cells later turn into bone<sup>85</sup>.

## **STOMACH FLU**

Colloquially, some refer to 24-hour bouts of diarrhea and/or vomiting as the “stomach flu,” but there is no such thing. “Stomach flu” is probably something that disagreed with you, and less often food poisoning or a virus like Norovirus.<sup>86</sup>

## **SUGAR**

Low carbohydrates became a new diet craze after low-fat product sales reached a plateau. Sugars are one of the three important food sources we con-

sume, but there is now a belief that some sugars are different than others; added sugar vs. high-fructose corn sugar vs. bleached or “raw.” Whole Foods was so concerned about the added sugar stigma that they invented a new term for it: “evaporated cane juice.” Because of obesity concerns, cities are instituting “soda taxes” to penalize sugar consumption, yet they leave out fruit juice, yogurt, and smoothies, which are high in sugar. Ironically, a new study in Australia showed that obesity continued to rise even as sugar consumption decreased<sup>87</sup>. That’s because sugar isn’t the problem; the real culprit is too many calories and not enough exercise.

## **SUNSCREEN**

Hyper-conscious parents have been scared by environmentalists into believing that sunscreen may be more dangerous than baking in the sun. No, it’s not<sup>88</sup>. Melanoma and other skin-related cancers have gone up because cancer takes time to develop and sunscreen was not used in the past, tanning oil was. Sunscreen is perfectly safe.

## **SULFITES**

People have heard of these because of “red wine headaches.” Sulfites occur naturally in all wines as a byproduct of fermentation, and many vintners add additional sulfites as a preservative. Sulfites may be an allergen for some people, but they don’t cause “red wine headaches”<sup>89</sup>. The cause of wine-induced headaches is unknown.

## **TALCUM (BABY) POWDER**

Unscrupulous lawyers have used junk science



speculation to convince juries to award jackpot \$70 million verdicts over the notion that baby powder causes ovarian cancer<sup>90</sup>. It does not but they suggest that because talc in nature contains natural asbestos that commercial baby powder has caused various maladies, even though it has no asbestos. Or anything else harmful. In total, Johnson & Johnson has so far lost four lawsuits related to baby powder, totaling over \$300 million in judgments.<sup>91</sup>

## **THEORY**

The term “theory” is used very differently by scientists and society. In scientific parlance, a theory refers to a widely accepted explanation or unifying theme that is supported by observation and experiment. Quantum mechanics and general relativity are examples of theories that make up the current scientific consensus in physics. Colloquially, people use the word theory to mean an idea. Activists will claim their paranoia about cell phones causing cancer is a theory, but it is just speculation, because it lacks a valid biological hypothesis.

## **THIMEROSAL**

Thimerosal, a mercury-containing organic molecule used as a preservative in some vaccines, was wrongly blamed by activists for causing autism. They don’t understand that a molecule that contains mercury is not the same thing as mercury itself. In the same way that the fundamental character of hydrogen and oxygen change when they join to form water, the fundamental nature of mercury

changes when it joins other atoms in a molecule.

### **THIRD-HAND SMOKE**

Third-hand smoke is a term that refers to tiny specks of particulate matter left behind by smokers, presumably which leap into the lungs of unsuspecting bystanders to trigger disease. This is a science-free money grab that seeks to leverage the real harm of smoking for financial gain.

### **THREE-PARENT IVF**

Women who have an abnormality in their mitochondria (the energy powerhouses inside cells) may produce sick children who die young. A new technique based upon IVF to replace these defective mitochondria with healthy versions has been derided as creating “three-parent embryos,” which is emotionally loaded junk science. Whether they have the parents’ hair color or any other characteristic is unchanged, any more than replacing a spark plug in a car will turn it from a Mercedes into a Subaru.

### **TOILETS**

The reason your toilet doesn’t work is because our government passed a law restricting flushes to 1.6 gallons each. Junk science claims that this is necessary to conserve water, even though water is not a scarce resource in most of the United States. It’s also recycled efficiently in our sewage systems.

### **TRANS FATS**

Trans fatty acids are partially hydrogenated oils (e.g., Crisco), which were originally marketed as a healthier plant-based alternative to saturated

fats from meat. Food warriors (incorrectly) promoted them as healthier but are now opposed because trans fats have been linked to higher levels of LDL (“bad”) cholesterol. The hype against them is not much different than the hype that made them popular, but except for donuts and pie crusts they are mostly out of the food supply.

## **TURMERIC**

Turmeric is a spice used in certain foods. It is not a superfood, despite claims that the active compound (curcumin) works miracles in arteries. Don’t inject turmeric directly into your bloodstream because that will kill you, as one woman found out.

## **TWIN STUDY**

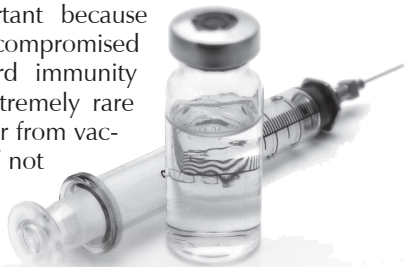
Twin studies are a clever way to tease apart the influence of genes and the environment on various personal characteristics. However, twin studies have yielded bizarre results, such as the notion that genetics plays a larger role than the environment in shaping political beliefs. The assumptions underlying the twin study methodology may not be correct, so twin studies should be met with skepticism<sup>92</sup>.

## **UNION OF CONCERNED SCIENTISTS (UCS)**

Despite its name, the Union of Concerned Scientists (UCS) employs mostly political activists rather than scientists. It is often quoted in the press, despite the organization using its \$32-million budget to lie about GMOs and nuclear power.<sup>93</sup>

## VACCINATION

Vaccines are the single biggest triumph of 20<sup>th</sup> Century medicine. Thanks to vaccines, smallpox (which killed 300-500 million people in the 20<sup>th</sup> Century alone) is eradicated, and other diseases like polio, diphtheria, and measles are rarely seen in advanced countries. Yet, vaccination remains important because infants and immunocompromised people rely on herd immunity to protect them. Extremely rare side effects can occur from vaccines, but the risk of not vaccinating is vastly greater.



## VAGINAL STEAMING

Endorsed by actress Gwyneth Paltrow, vaginal steaming claims if a woman sits over steaming water made with certain herbs, it will balance her hormones and help her uterus. A review declared it “sorcery for your vagina.”<sup>94</sup>

## VEGANISM

Veganism is an extreme form of a vegetarian diet, which eliminates not only animals but animal products, like dairy. Claims of health benefits are junk science, but it isn't harmful if dieters supplement important nutrients, like vitamin B12<sup>95</sup>. People can choose to follow a vegan diet for philosophical reasons, but there is nothing magical about veganism.

## **VINYL CHLORIDE AND PVC**

Vinyl chloride is carcinogenic, but junk science claims that plastics made of polyvinyl chloride (PVC), a polymer, are also harmful. PVC is used to make almost all water pipes and is completely safe.

## **VITAMIN SUPPLEMENTS**

Healthy people who eat a relatively balanced diet (i.e., one that does not consist exclusively of hot dogs and Twinkies) do not need to take multivitamins or other dietary supplements. If you think you are deficient in a particular vitamin (such as vitamin D if you live in a cloudy place), consult your doctor. Despite being debunked for decades, junk science claims mega-doses of vitamin C will cure or prevent colds. At the very most, daily supplementation with vitamin C might reduce the duration and severity of a cold<sup>96</sup>.

## **WEIGHT LOSS REGIMENS**

Junk science is king in the realm of weight loss regimens. The only guaranteed way to lose weight is to consume fewer calories than you burn.

## **WHOLE FOODS**

Whole Foods shoppers believe that their upper-class lifestyle is healthier, tastier, and better for the environment – yet science shows none of that is true. A bigger concern is Whole Foods's book section, which is a nexus of junk science.

## **WI-FI**

Junk science has led some people to believe that Wi-Fi is making people sick, particularly children, and the telecommunications industry is covering

it up. Like cell phones, Wi-Fi devices rely on the radio-frequency portion of the electromagnetic spectrum, which is also utilized by everyday devices such as broadcast TV, radios, microwaves, and satellites. You can surf the web without fear.

## WIND POWER

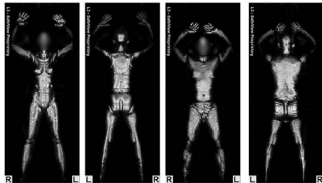


Wind power could be a useful regional source of energy in windy places, but it won't work on a national scale because it is too inconsistent and the technology to store and transmit large amounts of energy does not exist yet. Like geothermal or hydroelectric, wind power is best suited for places where nature

has made it viable. Junk science in support of wind power has resulted in pointless subsidies, and junk science opposed to wind power claims it kills too many birds.

## X-RAY SCANNERS

Full-body scanners at U.S. airports use backscatter X-rays. That sounds scary, which is why Europe banned them. The radiation from such machines is actually



miniscule, equivalent to the radiation that a traveler would get in 12 seconds of flying on an airplane or 1.8 minutes standing just about anywhere on Earth<sup>97</sup>.

## **YUCCA MOUNTAIN**

Yucca Mountain is perhaps the most studied piece of real estate on the planet. Decades of scientific analysis declared it a safe location for long-term storage of nuclear waste, especially in comparison to the over 100 sites in use now. Even if a leak occurred, the amount of radioactivity would be less than that found naturally in the rocks underneath the Colorado River, which supplies drinking water to much of the Western U.S.<sup>98</sup> Due to environmental fearmongering and politics, Yucca has been perpetually delayed.



## ACKNOWLEDGMENTS

A large and sincere “Thank you!” goes to the entire ACSH team, particularly Hank Campbell, Josh Bloom, Ruth Kava, Julianna LeMieux, and Jamie Wells who provided invaluable help with the preparation of the manuscript.

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