

## Brain Morsels: Packet 9



**EACH BRAIN MATTERS**  
THE CENTER FOR NEUROSCIENCES FOUNDATION

### Food that Nourishes Your Brain

This issue of *Brain Morsels* returns us to the pillars of brain health, **this time the pillar of “good diet.” The goal is to think about what the brain’s special requirements are.** Perhaps you have heard that “What’s good for the heart is good for the brain!” That makes sense as the brain depends on the heart for its oxygen and nutrient supply. What is far less commonly understood is that the brain has special nutrient requirements and that it carefully regulates what is allowed in. Think of the brain’s environment as a protected one, where some molecules are actively restricted and others are actively gathered. Much of the information about diet that you’ll find below comes from a book called *Brain Food* ((2018) New York: Penguin Random House) by Lisa Mosconi, PhD, who is both a neuroscientist and a certified nutritionist.

Think back over the years to the myriad diets that have become the diet du jour – the grapefruit diet, the keto diet, the Adkins diet, the whatever diet. Some are crazy on their face. Others ignore basic nutritional science or are based on pseudoscience. What is entirely clear is that our typical Western diet is radically different from the diet in which our species evolved, which was high in fish, in freshwater species, and in seasonal fruits, vegetables, seeds and grains. Our food industry by contrast has employed refrigeration, chemical preservatives, and chemical ripening to allow long-distance transportation and extended storage. It uses highly processed ingredients and ingredient combinations to produce products that are so pleasing to our palates, even when they are nutritionally vapid. It has enhanced convenience while at the same time grossly reducing actual nourishment and introducing chemicals that our bodies are not designed to handle. It is not at all surprising that so many of our children are heavy and that so many of our adults also are too heavy and have chronic diseases like high blood pressure, heart disease, diabetes and cancer.

You may have heard of the world’s **Blue Zones**, places where much of the population reaches their 90s or 100s, mostly free of chronic diseases, *including dementia*: Loma Linda, CA; Nuoro and Ogliastra Provinces, Sardinia, Italy; Nicoya Peninsula, Costa Rica; Okinawa, Japan; and Ikaria, Greece. While research about people in these zones shows that it is overall lifestyle that seems to be key, including staying physically active and having a strong social network, diet also plays a major role. With Blue Zones in such geographically diverse locations, regional differences in diet are expected, but the basics are similar. Their diets are plant-based, feature unprocessed foods, with legumes (like peas and beans) as staples, free use of herbs and spices (so, minimal salt), moderate to low levels of protein and fat, rare meat intake, some wild-caught fish, use of lots of anti-oxidant foods (olive oil, curcumin, turmeric, green tea, coffee and cocoa drinks), and sweets in very small portions (maybe a couple of times a week.) Overall, portions are small, and calorie

intake is moderate. Meals are heartiest in the morning and at lunch, with just a small dinner. Many of you will recognize this as a version of the **Mediterranean diet**. In 2023, *The Journal of the American Medical Association* published a report on a 36-year study of more than 75,000 women and 44,000 men who followed that diet. Their findings? Yes, that diet played a major role in reducing inflammation and oxidative stress.

A quick note to answer the question, *what is oxidative stress?* Under normal physiological conditions, metabolism produces short-lived very unstable molecules called *free radicals* that can interfere with or disrupt the function of proteins, fats and even DNA. If there are enough antioxidants available in the cells, the antioxidants balance out the free radicals, and there is no oxidative stress. If the balance shifts chronically toward the free radicals, however, these agents can cause cellular damage, including damage to DNA. That, in turn, can contribute to the development of diseases like diabetes, inflammatory joint disease, atherosclerosis, and cancer. If this happens in the brain, which it certainly does, the consequences can include dementia.

Foods that typically increase the production of free radicals include refined sugars, processed meats, red meats and alcohol.

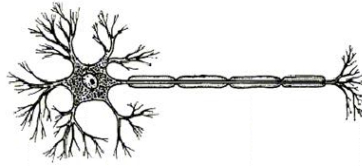
*Antioxidants are molecules that prevent other molecules from oxidizing by scavenging or decomposing them.* It's quite easy to get a fine dose of antioxidants each day. Vitamins C and E are powerful antioxidants. Foods that contribute antioxidants include berries, beans, artichokes, apples, plums, cherries, pecans and almonds, flaxseed, dark leafy greens. Surely you like some of those?!

A caveat. We suppose you need to know a small, but not surprising, caveat. As you age, your body is less efficient in fighting off the effects of free radicals, and thus is more susceptible to oxidative stress and the damage it causes. So, making sure to have a good, natural supply of antioxidants should be a serious dietary goal.

**Supplements.** Here is another general comment about our diets, this one having to do with use of dietary supplements. The supplement industry is huge and almost completely unregulated. What you get in a given container may or may not be what the label says in the amounts promised. Research also has shown that **nutritional supplements are processed in the gut less efficiently than when the same nutrient(s) are delivered via natural foods.** Natural foods deliver nutrients in a context for which our bodies have evolved to extract them most efficiently and thus process them more easily. In addition, natural foods contain a multitude of biologically active ingredients including some in almost vanishingly small, but apparently critical amounts. You can't get those via supplements. Note that supplements sometimes *are* prescribed, either when a person has a very low level of an essential nutrient, a level that would be hard to manage in the short term with just diet, or there is a metabolic situation that limits normal uptake of that nutrient. If this is the case for you, take the supplement prescribed! Finally, if you need more reason to beware, supplements also tend to be expensive.

## Activity

For 3 days, keep a detailed food journal. Include how much you drink and what you drink. Leave room after each meal's entry because later you will annotate your journal to indicate the nutrients you have taken in with that meal.



### What the brain wants, and why

1. **Enough water.** What's enough? Well, depending on your body size, of course, something like 6-8 cups a day – that's 48-64 oz a day or roughly a quart and a half to 2 quarts. And then, if you live in a desert, you probably need more than that. Is your response, "Heck no, I'd have to pee all the time!"? Those of us whose mobility is limited really don't want to have to get up more frequently for a trudge to the bathroom.

But, before you discard the notion entirely, know that brain tissue has a higher proportion of water than do the other body tissues, ~80% compared to 60%. The brain also is very sensitive to dehydration, so that as little as a 3 or 4% decrease can cause symptoms, like brain fog, headaches, mood swings, and fatigue. Also, elders often have a decreased sensitivity to thirst, so can get into trouble more quickly.



On the other hand, avoid the more-is-better notion, because too much plain water can lead to a condition called hyponatremia, in which the blood becomes too dilute. Sodium levels fall and can lead to nausea and vomiting, headache, confusion, drowsiness, fatigue, irritability, cramps, and restlessness. A lot of those symptoms are the same as with dehydration, which indicates that there is a sweet spot for adequate hydration. It's not a terribly narrow range though, as our bodies can compensate when there's a bit too much or a bit too little, but you do need to pay attention.

So, good mineral water or spring water is excellent as our brains need the minerals in natural water. The water that comes in plastic bottles usually is labeled purified, which actually means that all the good minerals have been removed. If tap water is not acceptable to you, research water and figure out what would work best for you, including the possibility of various ways to filter your water, without breaking the bank!

Limit fluids with sugar or artificial sweeteners or colored additives, and limit caffeine-containing fluids. Caffeine is a diuretic so consuming a lot of caffeine drinks can be dehydrating. As for reaching that needed number of ounces, know that lots of fruits and vegetables contain hefty amounts of water, possibly worth 8 to 16 or so ounces a day. Melons, peaches, strawberries, citrus, cucumbers, squash, celery, and lettuce all are mostly water. Hallelujah for nature's bounty!

2. **And what about proteins?** All cells, neurons included, require proteins to function. The process of signal transmission along neuronal processes and signal transfer across neuronal connections – the synapses – both require many proteins. In fact, there is an astonishing array of proteins located at synapses on both the sending and receiving sides; these proteins must act together to ensure that the signals to be transmitted from one neuron to the next are transmitted reliably and accurately. Most of the drugs we take (legal or not) to affect brain function, engage one or more of these synaptic proteins. The production of synaptic proteins is ongoing and the building blocks for many of those proteins must be supplied daily by our diet. Deficits in the essential proteins needed can result in serious depletion and serious consequences on emotional stability, sleep patterns, memory, appetite, movement, motivation, intentional activity, and inhibition of negative behavior and responses.

There are a couple of amino acids (the building blocks of proteins) that are essential for the brain and that must be acquired through our diets as neither the body nor the brain have the capacity to make them. Two in particular are tryptophan and phenylalanine.

Tryptophan is necessary to produce a key neurotransmitter – serotonin. Serotonin plays a key role in mood, sleep, and sexual desire, as well as an array of body functions. Tryptophan is found in common foods, like eggs, whole milk, whole-milk yogurt and cheese, edamame and tofu, fish and turkey, and pumpkin, sesame and chia seeds. For tryptophan to be useful, you also need Vit B6 as it is necessary in the process of converting tryptophan to serotonin.

When Phenylalanine is available, the body can produce tyrosine, which in turn is needed to produce the neurotransmitter dopamine. Dopamine is a key transmitter in circuits that affect our pleasure and



reward, motivation, attention, problem-solving and motor control. Animal sources include hard cheeses, chicken, beef, pork leg, codfish, salmon, seabass and, from plants, soybeans, peanuts, chia, almonds, sesame and pumpkin seeds, walnuts, chickpeas and lentils.

I'm guessing that you are starting to see why the diets of those Blue Zone inhabitants are so powerful. Those diets give the brain what it needs!

### 3. Carbohydrates

Finally, do we get dessert? Ever, on this brain-healthy diet? Well, yes, in very small amounts and not every day, but then, that makes dessert all the more a treat! No?

Really though, while simple sugars like white sugar and breads, pastas and baked goods do fit in the category of carbohydrates, what is needed is the more complex varieties of carbohydrates. Those break down more slowly and do not lead easily to the high blood sugar levels that underlie inflammation and insulin resistance. Insulin resistance is a condition in which the demand for insulin is chronically high due to high dietary intake of sugars, especially simple sugars, leading to inefficient use of insulin to move glucose into cells. That in turn keeps blood sugar levels consistently high. An inflamed brain is never a good thing. For example, cells in the hippocampus, that critical memory center in the temporal lobe, function poorly leading to decreased memory. Studies consistently show that the higher the blood sugar level, the higher the risk of dementia. Even with no dementia, older individuals with high blood sugar levels show decreased memory performance and brain shrinkage (by MRI).

Yet, the brain cares absolutely about blood sugar levels because it cannot use fats for energy, only glucose. So, in fact, glucose entry into the brain, while nearly continuous, is very tightly regulated so when glucose is excessive, the brain will restrict entry. In a pinch, if glucose levels fall too low, the brain has a limited capacity to convert other sugars, like fructose and lactose, into glucose. In the opposite direction, the brain also can take any *small* amount of extra glucose and convert it to glycogen for storage. And, in a worst-case scenario, say a condition of starvation, the brain can temporarily depend on the liver to produce ketone bodies. But even so, it still must get about a third of its energy from glucose. Complex sugars with their longer break-down time keep blood sugar levels reasonably stable rather than fluctuating widely. In short, glucose is essential for the brain, but chronically high glucose can overwhelm the brain's glucose regulatory system and chronically low glucose can be compensated for only so long before the brain is deprived of the nutrient on which its function depends.

The diet cognoscenti among you will have perked up when you heard ketone bodies mentioned, as in the famous, or perhaps we should say, the infamous keto diet. That diet is high in saturated fat, which is terrible for the body for many reasons (see below), and very low in the carbohydrates the brain requires, essentially forcing the brain to

depend on that liver backup. Again, that backup is intended for an emergency situation, and even then, glucose is still required.

What kinds of carbohydrates are helpful then? Natural sources are best (spring onions, turnips, dried apricots, kiwis, grapes, onions, red beets, whole wheat bread, honey, yams/sweet potatoes, garbanzo beans, black beans, lentils, berries and grapefruit (unless your meds prohibit it), winter squashes, carrots, whole grains. Note that many of these are fiber-rich, which supports gut health. According to Mosconi, just 3T of honey a day would let you meet the brain's daily glucose requirement! Easy!



#### 4. Fats

The story around fats is complicated, beginning with the fact that there are lots of different kinds of fats. Some fats are essential for the brain, and some are damaging when in the wrong proportion but helpful in the right proportion. For now, we'll provide an overview, but for detailed discussion, see Mosconi's *Brain Foods*.

A key difference between the brain and the rest of the body is that the brain cannot use fats for energy, nor does it store energy as fat. Instead, it uses fats for structure - for cell membranes and for the fatty myelin sheaths that surround the long neuronal processes (axons). Myelin serves as insulation that makes possible the extraordinarily fast transmission of neuronal signals. Because nearly all the neurons present in the adult brain are born in utero and in infancy, and because myelination of the axons is finished by a person's mid-twenties, the need for structural fats fades at the end of that period; any small amounts needed after that can be made locally in the brain.

The brain *does*, however, need a dietary source of poly-unsaturated fats, fats like omega-3s and omega-6s, to make the larger and complex structural fats that are used in the structure of cell membranes. These small fats are found in fish, eggs, nuts and seeds. OK, that should be easy to handle. Here is the rub though. Omega 6s can support inflammation, in a good way; they provide an appropriate inflammatory response, say to wounds or infections. Omega-3s balance that response, reducing inflammation as the threat wanes. **BUT**, the balance between these two is critical – too much inflammation can be damaging; too little reduces the ability to mount a strong response to disease or injury. Research indicates that there should be 2 omega-6's to 1 omega-3<sup>1</sup>. Our Western diets tend to be grossly out of balance, with a ratio of 20-30 omega-6s to 1 omega-3<sup>2</sup>. Highly pro-inflammatory and therefore damaging to the brain!

At this point, there are numerous studies identifying omega-3s as important agents in reducing the risk of cognitive decline. In one study of 6000 individuals who were 65 yr old or older, people with low levels of omega-3s had a 70% higher risk of developing Alzheimer's Disease, and MRIs of their brain showed greater shrinkage<sup>3</sup>. **The message clearly is: reduce foods high in omega-6s** - think fatty animal food like bacon, hot dogs, sausage and processed meats, and like mayonnaise and oils made from grapeseed, peanuts, soybean, corn, and sesame seeds. At the same time, focus on increasing your intake of foods high in omega-3s, like flaxseeds, walnuts, almonds, chia and sunflower seeds, and wheat germ, as well as fish oils, cold-water fish (salmon, mackerel and cod, sardines), eggs (poultry and fish), crab, peas, cucumbers, tapioca, oats, whole wheat, barley, and soybeans. Again, you should seek out natural foods rather than supplements. Do note that some daily omega-3 supplements cost more per day than the cost of a couple of teaspoons of salmon caviar to meet your brain's daily need, assuming you like the stuff!



<sup>1</sup> Simopoulos (1991) *American J Clinical Nutrition* 54: 438-463

<sup>2</sup> Kris-Etherton et al. (2000) *American J Clinical Nutrition* 71: S179-188

<sup>3</sup> Morris et al. (2003) *Archives of Neurology* 60: 194-200

Just a word about saturated and trans-fats. These are used by the food industry mainly to stabilize foods for long storage, or for creaminess. Sounds OK but nutritionally, saturated fats are BAD. High levels increase the risk of dementia, in part by creating inflammatory conditions in blood vessels throughout the body, which eventually reduces blood flow to the brain and increases the risk of heart disease and diabetes, both damaging to the brain. Trans-fats are even worse. Don't buy anything with any amount of trans fats. Though trans fats are mostly banned by the FDA, small amounts may still be found in coffee creamers, ready-to-use frosting, margarine, spreadable or creamy products, commercial doughnuts, cakes, pie crusts, biscuits, frozen pizza, cookies and crackers, even if the nutrient label says 0 trans fats. The FDA rule says amounts under 0.5 grams per serving do not need to be reported. So, look a bit more deeply. If the ingredient list includes any "partially hydrogenated" item, don't buy it! Eating saturated fats and trans fats can raise your cholesterol level considerably, and in doing so, raise your risk of dementia, especially if levels above 220 mg/dl occur in midlife. Know that your specific risk can depend on your genetics; high cholesterol and a family history of heart disease should be a red flag.

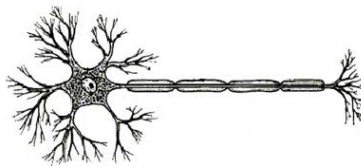
#### 5. Vitamins and minerals

Finally, we mentioned earlier the roles of Vitamins A and E as antioxidants. Both are stored in fat from which they can be released as needed and so generally do not need to be replenished every day. Vitamin C and the B Vitamin suite are water-soluble and cannot be stored; we need to take them in daily, preferably in natural foods. B6 is widely available – sunflower seeds and pistachios, tuna, shellfish, salmon, chicken, beef, spinach, bananas, wheat bran and wheat germ. B12 is found in shellfish, salmon, trout, mackerel, fresh tuna, chicken, eggs, beef and dairy.

The brain also needs magnesium, zinc, copper, iron, iodine, selenium, manganese and potassium. They are needed only in small amounts, though, readily available in a good diet.

### Activity

Take the food journal you made and now annotate it using the information above. Note for each food item whether it has proteins, complex carbohydrates, roughly the kind of fats, and whether it contains brain-important minerals and vitamins. AND, have you had enough fluid to drink?





There is no ideal diet for everyone, in part because there are genetic differences in how our bodies process food, in part because the nature of our gut-brain-microbiota interactions depend on what microbes we house, and in part because of our culture and experience with food. That said, providing the specific nourishment our brains need will reduce our risk of cognitive decline. And besides, a fine meal with friends is a great motivation for social and emotional nourishment!

In the next packet, we'll introduce the gut microbiota – the microbes – as major contributors to our health, brain included. For a fascinating story about what we understand about the microbiome, including how our diet needs to nourish the gut bacteria that in turn help us thrive, go to Ed Yong, *I Contain Multitudes* (2016) NY: HarperCollins Publishers.

On the next page you'll find a chart that lists foods that are especially good for the brain and those that you should decrease or eliminate entirely from your diet. We do know that the latter list will make many sigh. But I really *like* x or y or z! Sure. Eat them in small amounts or as occasional treats and eat slowly so that you actually taste and enjoy them. Our aging senses of taste and smell aren't as robust as they used to be, so play with using different herbs and spices, just not more salt. And adding a friend or two as fine companions makes almost any meal better!

## Key foods that nourish the brain, and those that don't!

Nutrient	Sources	Limit or eliminate
Water/fluid	48-64 oz of fluid a day which can include the water in many fruits and vegetables (typically 8-16 oz). Best: spring or mineral water.	Drinks with sugar or artificial sweeteners, food coloring, lots of cream or creamer, lots of caffeine
Proteins	<p>Tryptophan (amino acid): eggs, whole milk, whole-milk yogurt, cheese, edamame, tofu, fish, turkey, pumpkin seeds, chia seeds, sesame seeds</p> <p>Phenylalanine (amino acid): hard cheeses, chicken, beef, pork leg, codfish, salmon, seabass, soybeans, peanuts, chia seeds sesame seeds, pumpkin seeds, almonds, walnuts, chickpeas, hummus, lentils</p>	
Carbohydrates	Yams/sweet potatoes, garbanzo beans, lentils, black beans, whole grains, turnips, dried apricots, kiwis, grapes, onion, red beets, whole wheat bread, honey, berries, grapefruit, spring onions, winter squashes, carrots	Simple sugars and the breads, pastas, and baked goods that are made with them. Ice creams and other high sugar desserts, candy
Fats	Foods high in omega-3s: walnuts, almonds, chia/flax/sunflower seeds, wheat germ, fish oils, cold-water fish (salmon, mackerel, cod, sardines), poultry and fish eggs, crab, peas, cucumbers, tapioca, oats, whole wheat, barley, edamame	<p>Foods rich in omega 6s: bacon, hot dogs, sausage, processed meats (cold cuts), mayonnaise, oils made from grapeseed, peanuts, soybeans, corn, and sesame seeds.</p> <p>Any food containing a partially hydrogenated ingredient or trans fats. Look carefully at ingredients in coffee creamers, ready-to-use frosting, margarine, spreadable or creamy products, commercial donuts, cakes, pie crusts, biscuits, frozen pizza, cookies and crackers.</p>
Vitamins and minerals	Vit B6 and 12: Sunflower seeds, pistachios, shellfish, salmon, trout, mackerel, fresh tuna, chicken, beef, spinach, eggs, dairy, bananas, wheat bran and wheat germ.	

## Puzzles

Puzzle 1. Memory. Select 12 pairs of cards from a standard 52-card deck – 2 aces, 2 Jacks, etc. Shuffle your cards and then lay them face down in four rows of six cards across. Flip over two cards at a time. If the cards match, remove them from the rows. If not, flip them back over and try again with two more cards, one of which could be the same. Keep playing until you find all the matches. As you improve, add more pairs to your starting set. This game challenges your memorization skills, and it's a quick way to add a brain game into your routine that you can play by yourself.

Puzzle 2. More memory. Make it a wee bit competitive by doing this with a friend.

Look at the picture for 1 minute then turn it over and write as many things as you can remember



Puzzle 3. Try this. What one word can be added to all 5 of the words below to make 5 new words?

estimate      dog      write      age      hand

Puzzle 4. A riddle: What starts with a P, ends with an E, and has a million letters in it?

Puzzle 5. Here are 3 matches. Can you make 4 without breaking one?



### Puzzle 6.

Jigsaw puzzles engage your short-term memory to memorize and match shapes and colors. With each match, there is a small delight (alias dopamine). Doing a puzzle also tends to quiet your mind and let you get lost in the puzzling. Some people might need a small puzzle – perhaps 200 pieces; others like the challenge of a bigger one. A nice add-on to the pleasure of doing a puzzle can be doing a puzzle with another person – a fine social interaction, even if there is little talking.

### **Answers**

3. Add the word “under.”
4. The **P**ost Office.
5. Rearrange the 3 matches to make the number 4.

*Note: this and puzzles 4&5 come from ESLvault.com.*