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Selenium's Pivotal Roles in Relation to Mercury Exposure Risks

PROMOTING HEALTHY COMMUNITIES: Developing and Exploring Linkages Between Public Health Indicators, Exposure and Hazard Data

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CHEMICAL CONTEXT

1b	2b	3a	4a	5a	6a	7a	0
							He
		B	C	N	O	F	Ne
		Al	Si	P	S	Cl	Ar
Cu	Zn	Ga	Ge	As	Se	Br	Kr
Ag	Cd	In	Sn	Sb	Te	I	Xe
Au	Hg	Tl	Pb	Bi	Po	At	Rn

Se-PHYSIOLOGY BACKGROUND

- Selenium is an essential nutrient that is abundant in seafoods.
- Selenium-dependent enzymes perform vital functions in brain tissues.
- Selenoenzymes are genetically unique and functionally elite.
- It was thought that there were only 20 genetically encoded amino acids.
- Selenoenzymes employ selenocysteine, the 21st genetically encoded amino acid—which is the most powerful intracellular nucleophile.
- Selenoenzymes recycle vitamin C and other vital molecules that detoxify dangerous oxygen species, thus preventing oxidative damage.
- All forms of life that have recognizable brains have selenoenzymes present to protect their brains.

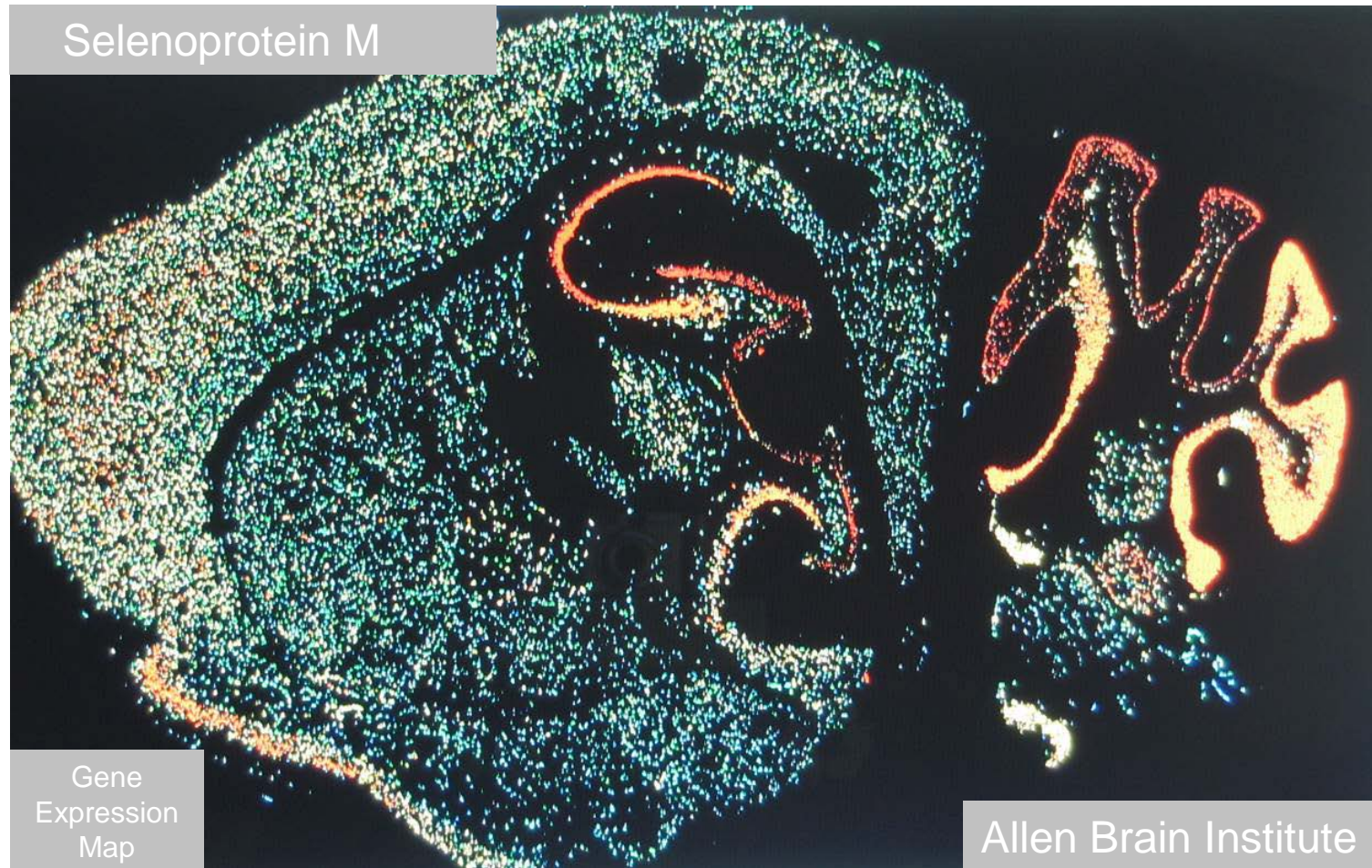
WHAT MAKES A SELENIUM PHYSIOLOGIST GET INTO MERCURY TOXICOLOGY?

- The only environmental challenge that significantly impairs brain selenoenzymes is mercury exposure, especially if it occurs during fetal growth. Studies have found that developing children can be harmed if their mothers eat seafoods that contain more mercury than selenium.
- Pilot whale meats (source of >90% of Hg exposure in the Faroes study), have Hg:Se molar ratios of 4:1!
- Although the Hg:Se ratios in king mackerel and tilefish have not been assessed, but sharks have ratios of 2:1 or even higher, swordfish; 1:1. These seafoods should be avoided during pregnancy as recommended by the 2004 FDA/EPA advisory.
- Ocean fish generally contain far more Se than Hg, and protect against rather than contribute to causing Hg toxicity.

SELENOPROTEIN W mRNA IN BRAIN TISSUES



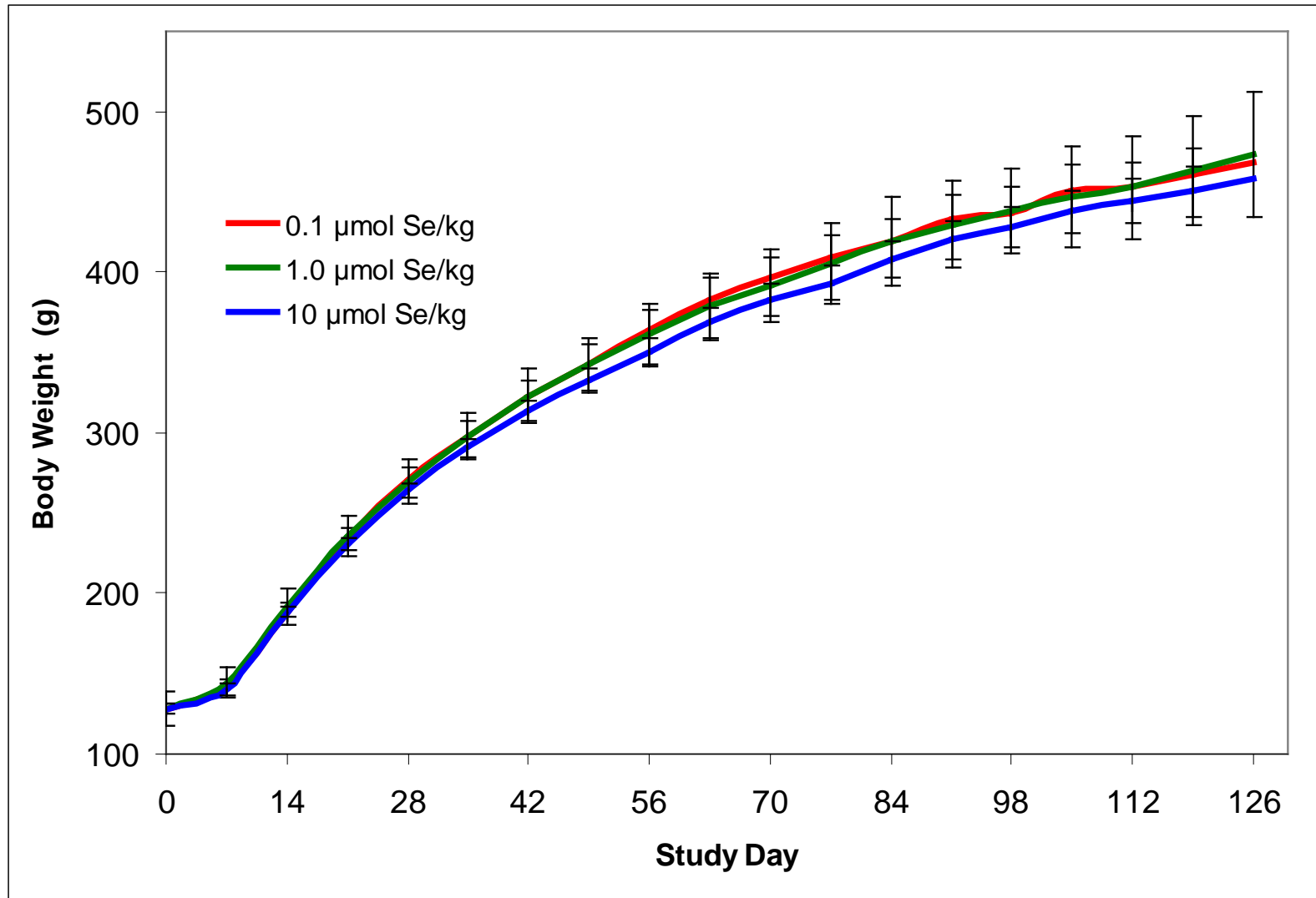
SELENOPROTEIN M mRNA in BRAIN TISSUES



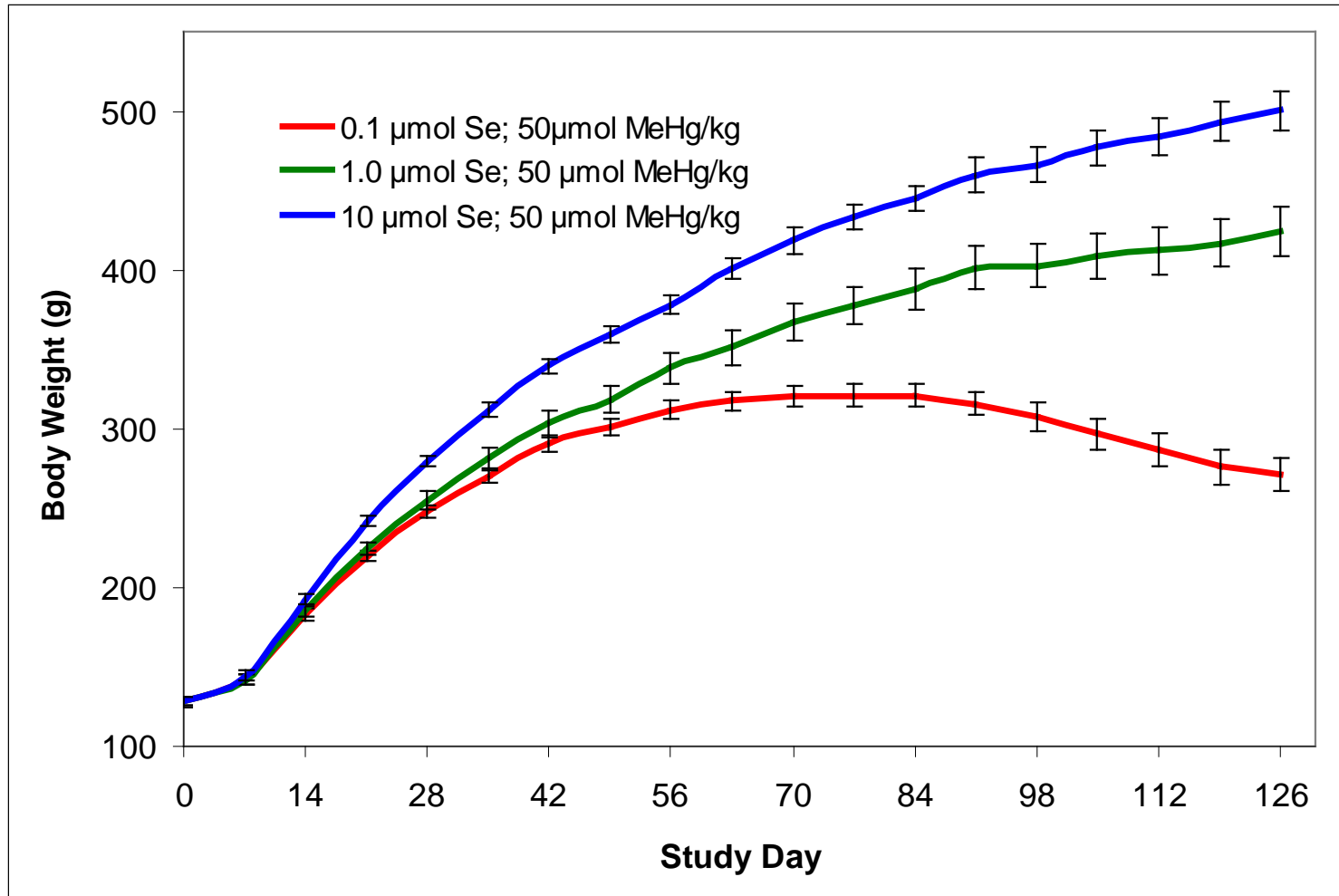
METHYLMERCURY TOXICITY

- Toxic effects of high MeHg exposures are well established.
- Implications of low level MeHg exposure had been uncertain.
- Human and animal studies demonstrate that MeHg exposure is increasingly hazardous as Hg:Se molar ratios increase.
- Selenium's protective effect against MeHg toxicity has been demonstrated in all species studied
- Selenium is not a “tonic”, it is the “target” of MeHg toxicity.
- MeHg irreversibly inhibits selenoenzyme activities in brain.
- Selenoenzyme activities in the fetal brain are extremely sensitive to maternal MeHg exposure.

DIETARY SELENIUM AND GROWTH



SELENIUM'S PROTECTIVE EFFECT (AGAINST MeHg TOXICITY)

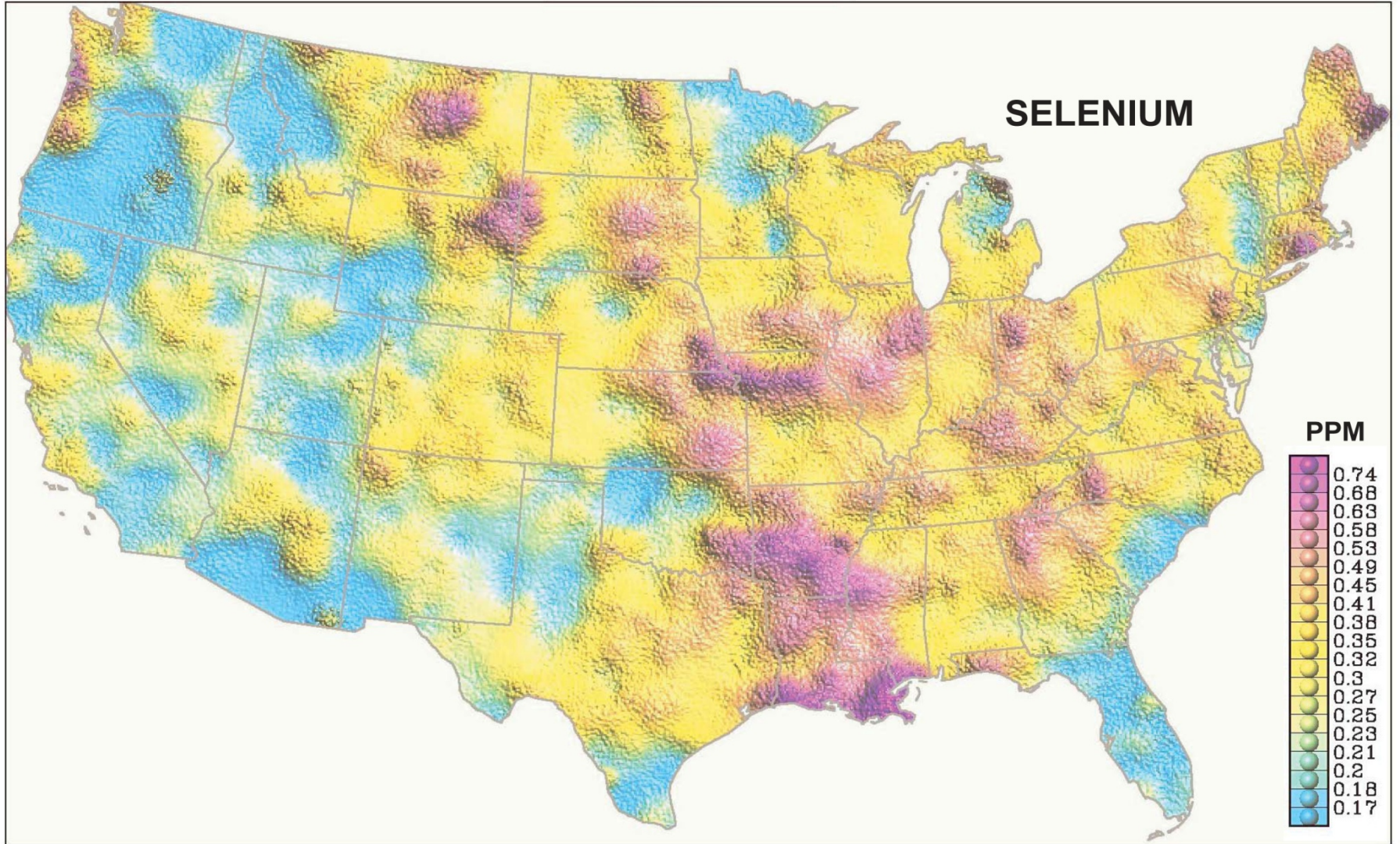


SELENIUM'S ROLE IN THE MERCURY ISSUE

- The effects of mercury toxicity correspond with the effects expected to accompany loss of selenoenzyme activities in brain and other tissues.
- Previous approaches to evaluating risks related to mercury exposures appear to have been overly simplistic (Imagine evaluating bankruptcy risks, but only considering debts and ignoring debt:income ratios. This approach could not reliably provide accurate predictions of risk).
- Consumption of selenium-rich ocean fish enriches the selenium status of the consumer, protecting them against mercury toxicity rather than increasing their risks.
- However, consumption of fresh water fish that have high mercury, but poor selenium contents may pose far greater risks of toxicity than has previously been expected.

DISTRIBUTION OF SELENIUM IN U.S. SOILS

0 1,000 KILOMETERS

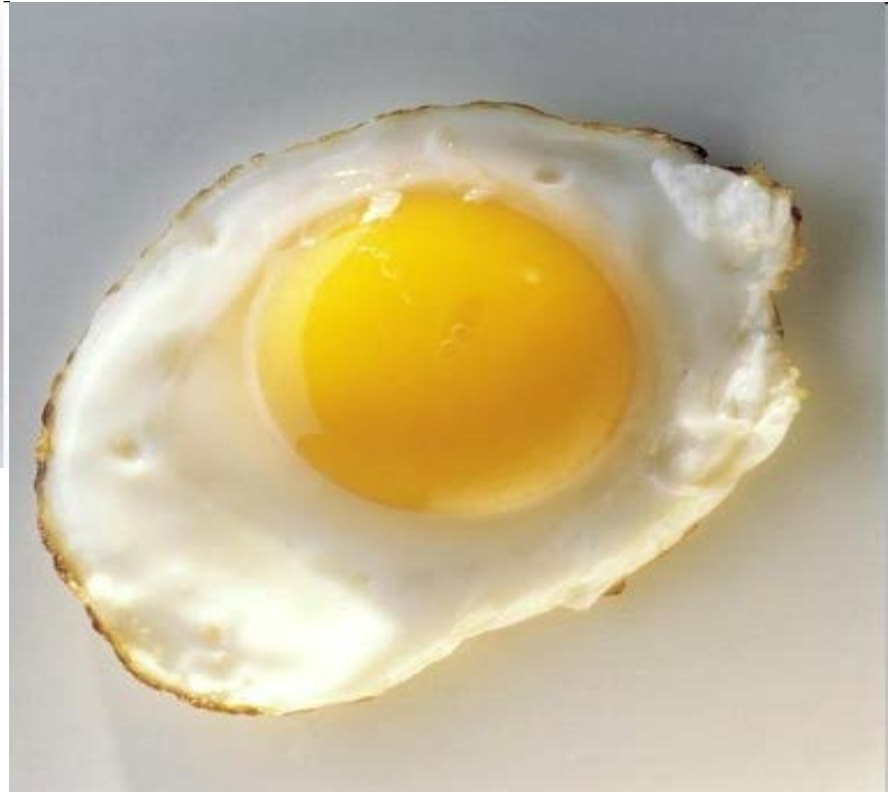


IN SUMMATION

Methylmercury is the only challenge that impairs brain selenoenzyme activities.



This is your brain



This is your brain without selenoenzymes...

Any questions?