Environmental Influences on the Thyroid

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Thyroid Hormone

Brain Development

- Thyroid hormone is essential for normal brain development.
- Fairly modest levels of thyroid hormone insufficiency are associated with cognitive deficits at the population level.
- The timing of thyroid hormone insufficiency is important.

How we know this

- Historical observations identified an association between maternal goiter and cretinism in the infant.
- Observations in both experimental animal systems and in humans show that “mild” thyroid hormone insufficiency affects brain development.

https://www.hhmi.org/biointeractive/development-human-embryonic-brain

Environmental Goitrogenesis

- So, the concept evolved that there are environmental factors that cause goiter. These factors are things like:
  - low dietary iodine
  - The presence of natural chemicals in food that inhibit thyroid function
  - Etc.
- And while these causes of low thyroid hormone (i.e., goitrogenesis) are important, the assumption became that if thyroid hormone levels are “normal”, then the thyroid system is working fine.

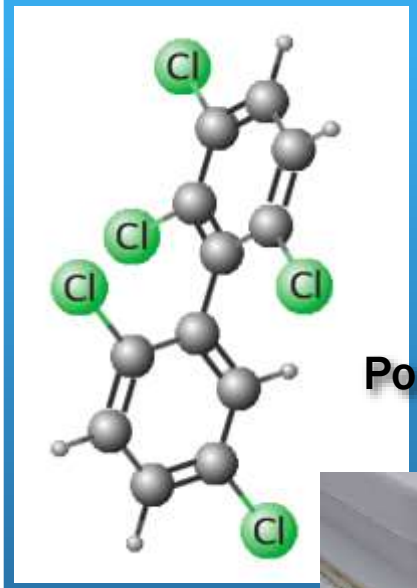
Modern Manufactured Chemicals

- The problem is that we now understand better that thyroid hormone action in tissues (e.g., fetal brain) can be controlled to some degree by the tissues themselves.
- These “tissue autonomous” mechanisms include selective transport of thyroid hormone into cells and the activation (and deactivation) of the hormone
- Importantly, we are now exposed to chemicals that nature didn’t make, and that can interfere with thyroid hormone action in a manner that does not affect thyroid hormone levels in the blood.

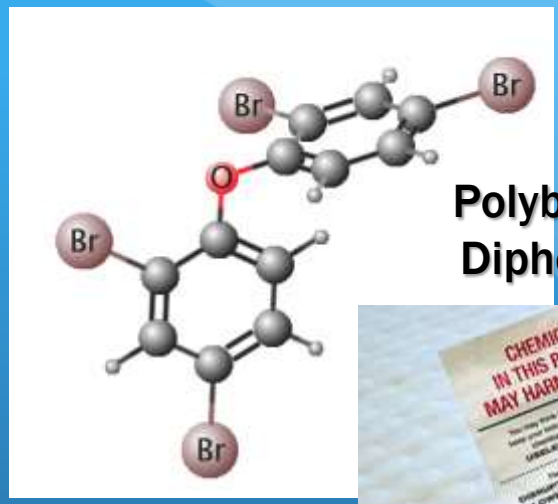
In other words

- Goitrogenesis = bad
- No goitrogenesis doesn't necessarily mean it is OK.

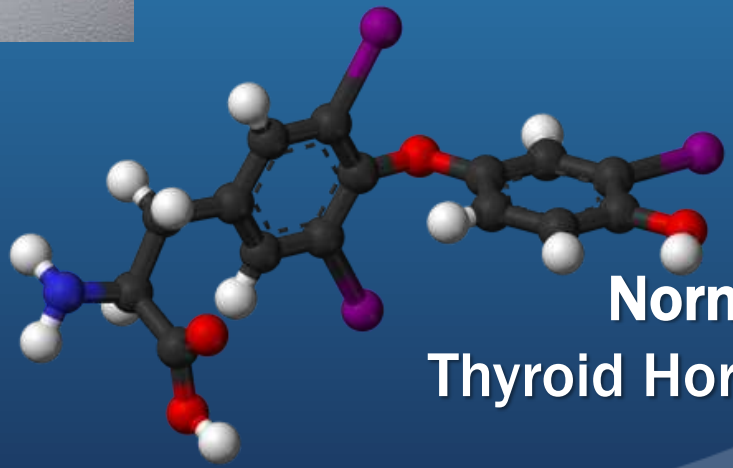
Modern Manufactured Chemicals



Polychlorinated Biphenyls



Polybrominated Diphenyl Ethers

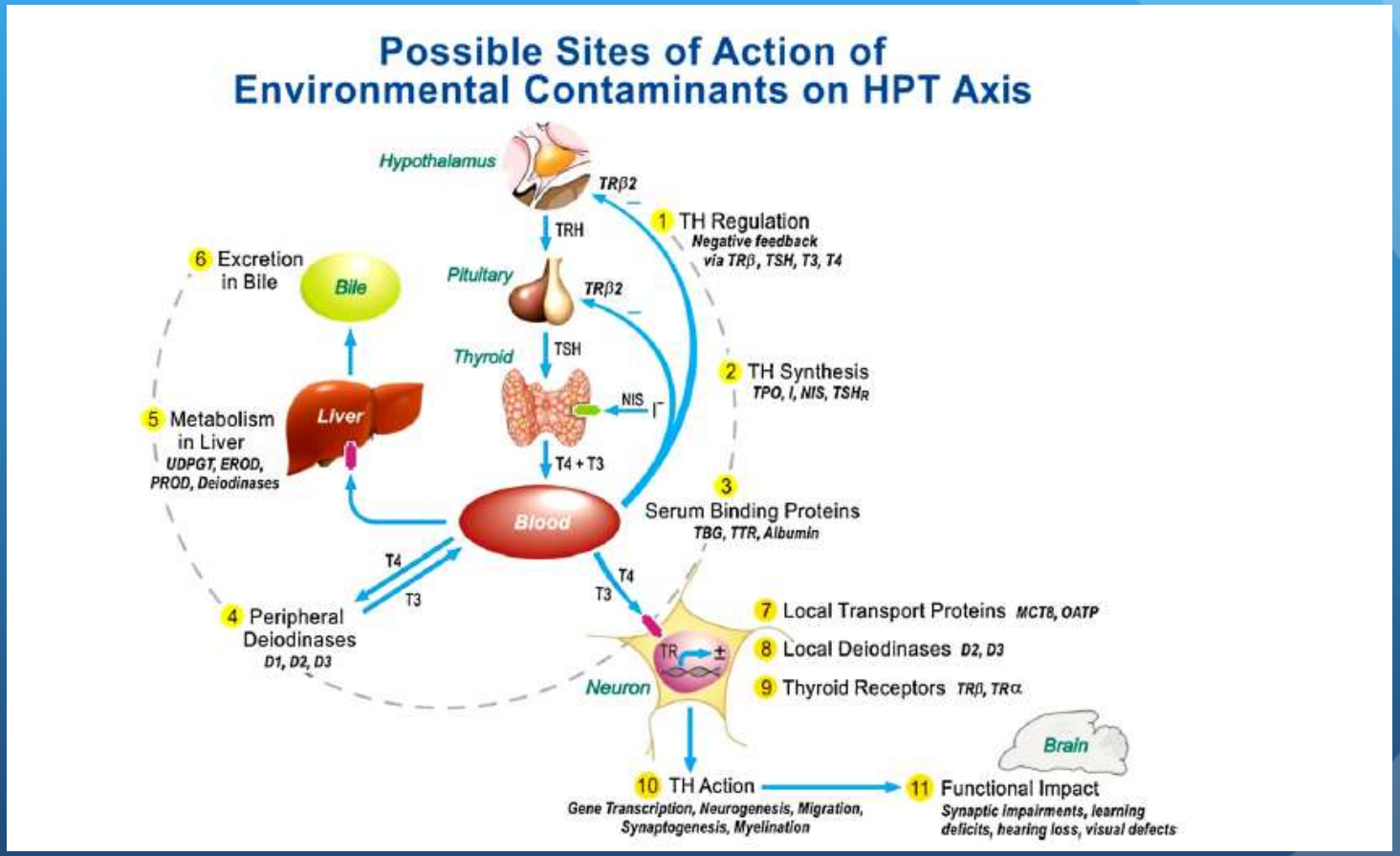


Normal:
Thyroid Hormone (T_3)

Modern Manufactured Chemicals

- These chemicals are not “natural”, so the concept of humans having evolved defense mechanisms is probably not appropriate.
- These chemicals can affect the thyroid system in a manner is that not identified by (regulatory) toxicology programs which focus on hormone levels.
- What are some of these ways:

Modern Manufactured Chemicals



Mary Gilbert et al. 2012 Neurotoxicology 33(4):842-852

Environmental Influences on the Thyroid - Conclusions

- Thyroid hormone is essential for development and for adult health
- Severe effects are observed when thyroid hormone levels are very low or very high (both in development and adult).
- Recent research indicates that some manufactured chemicals can interfere with thyroid hormone action – and produce adverse effects – in a manner that is not revealed by changes in blood levels of hormone.
- The regulatory system (in the US and Europe) has failed to to address this by incorporating endpoints of thyroid hormone action.