LLI Class 2: Chemical Pollution

PFAs, acidification, EDCs, Pesticides:

Impacts on senses, development and risk of neurodegenerative disease

Today’s plan

- Types of environmental chemicals released by human activities and routes of exposure
- Acute toxicity effects
- Olfactory function and impacts
- Chronic impacts: focus on endocrine disruption
- Thyroid hormone- one example
- Neurodegenerative disease

Mystery Illness afflicting dogs near Las Vegas

- There are lots of examples of pets being poisoned by lawn chemicals, even from swimming in lakes where there's a lot of lawn run off.







Environmental Poisons

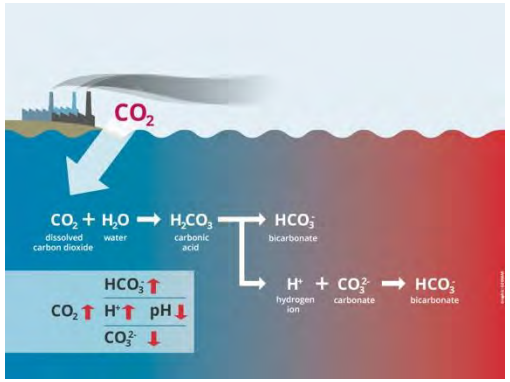


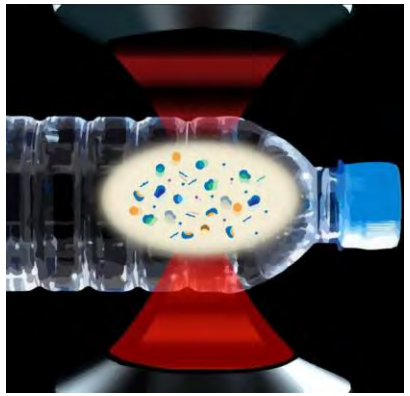














Primary exposure routes

- Ingestion
- Inhalation
- Contact











Chemicals- plastics, pesticides, pharmaceuticals, fossil fuels

Found all over the planet, in all ecosystems, all organisms tested







- Misleading olfactory cues- predator/prey, mating, foraging, habitat selection, migration to natal waters
- Disorientation, behavioral dysfunction
- Oxidative stress, endocrine disruption to neural development

Acute toxicity effects:

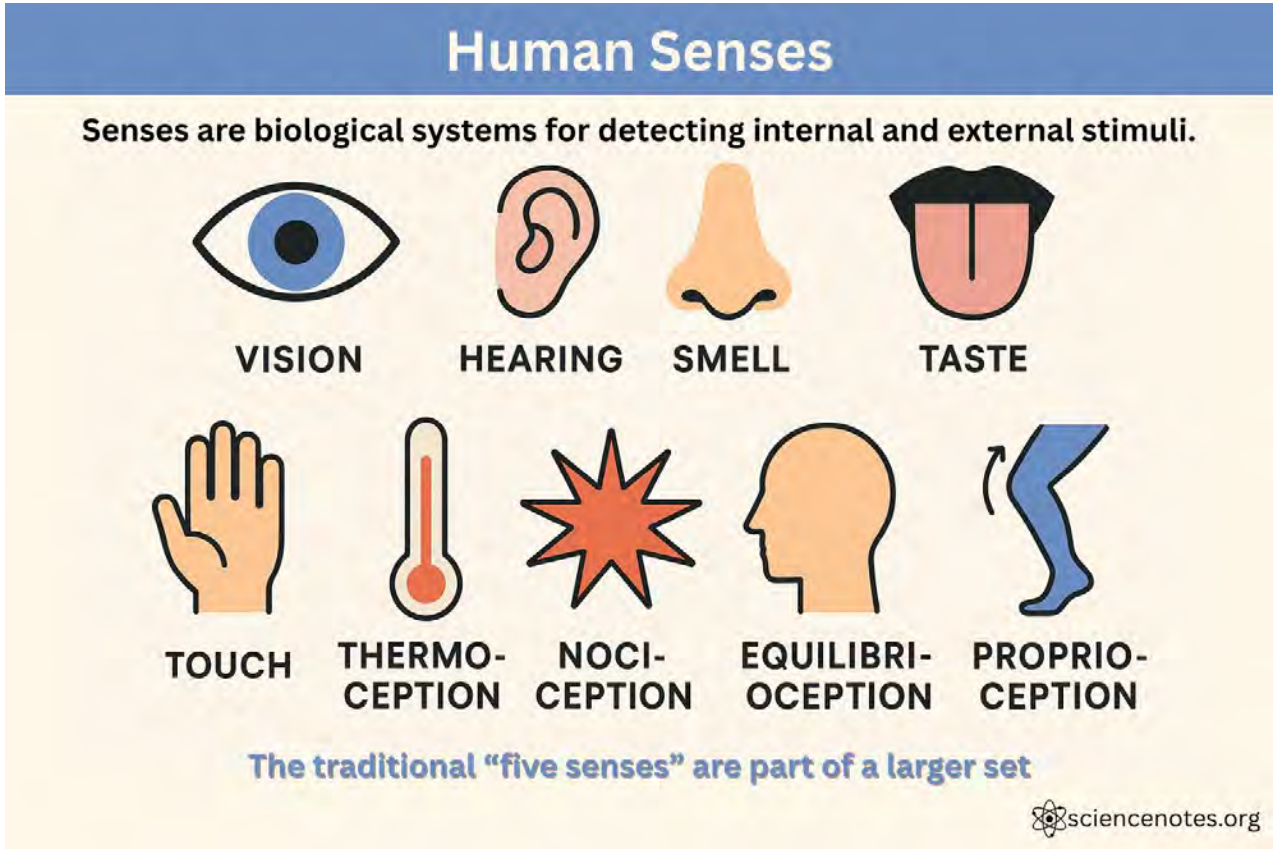


- Eye, skin irritation, nose/lung irritation
- Headache, nausea, chest pain, confusion
- Tremors, twitching, salivation, fatigue, stinging/itching skin
- Convulsions, difficulty breathing, coma, death

But, what if you are exposed daily, or weekly, or multiple times a year, over years and years? Most of us are exposed chronically…

Many environmental chemicals interact with sensory systems

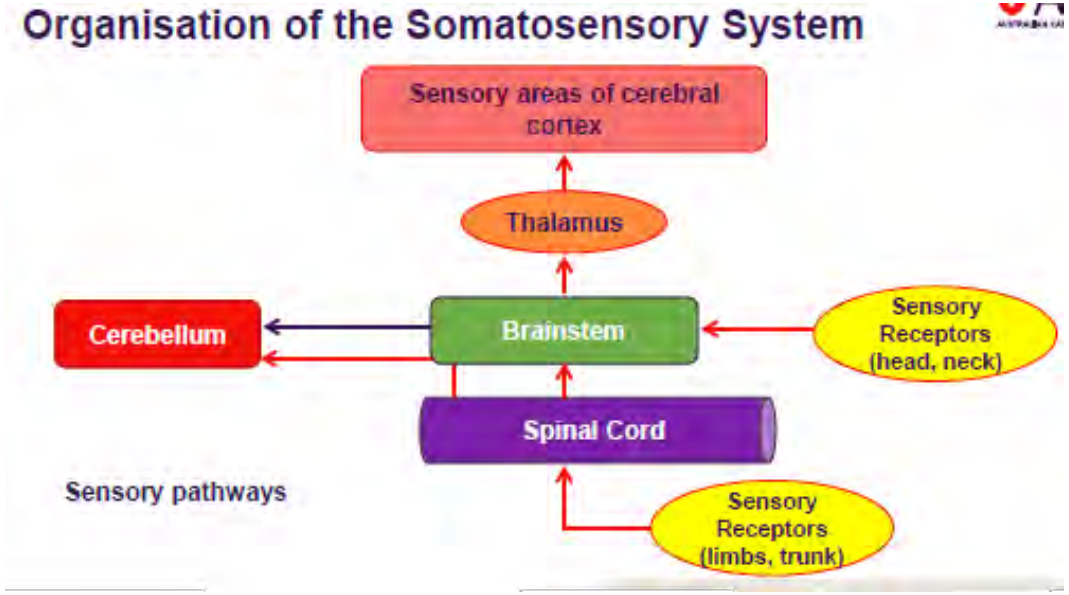
- Recall, last time, first point of contact….where are our sensory organs and receptors located?

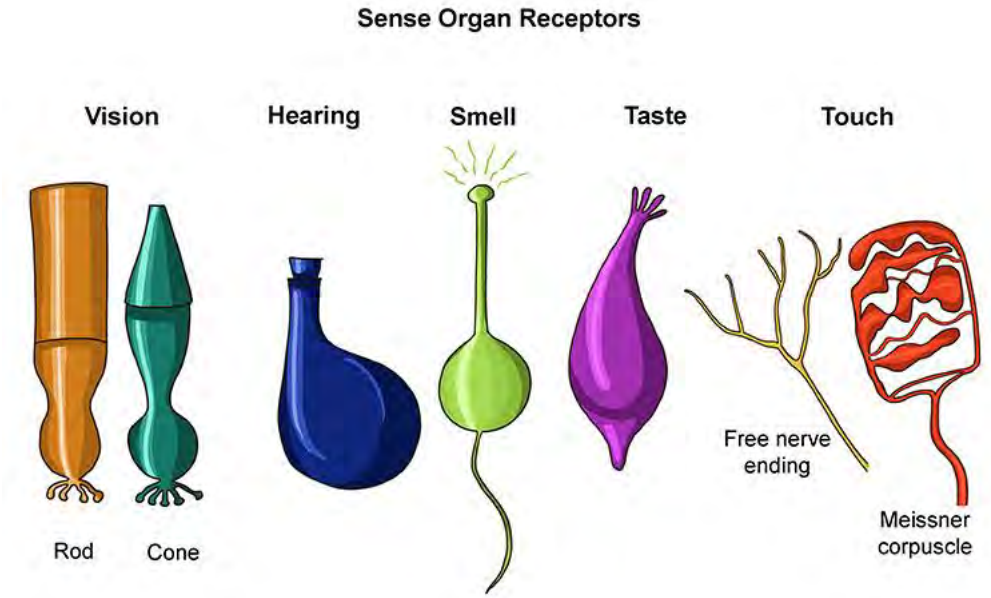


9= interoception

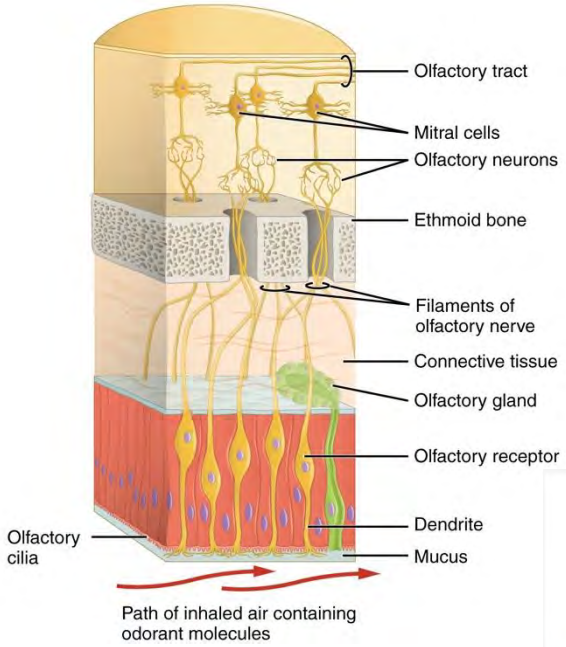
Basics of sensory perception- overview

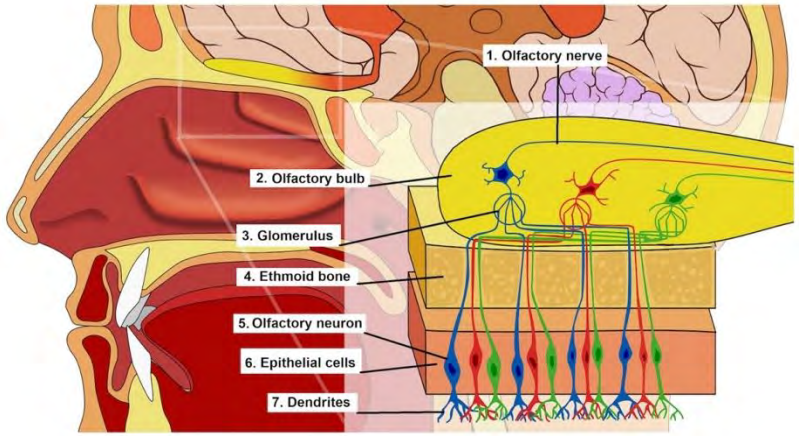
- Types of receptors and signal transduction
- Threshold, receptive field, discrimination, tuning
- Peripheral and central features of sensory processing

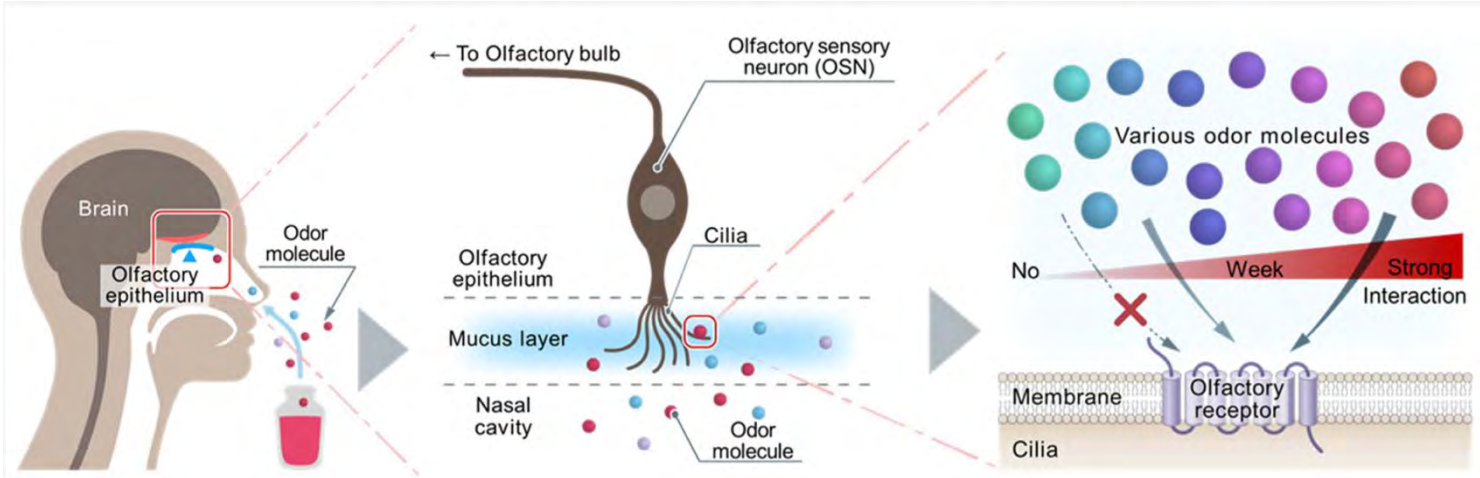




Olfactory System







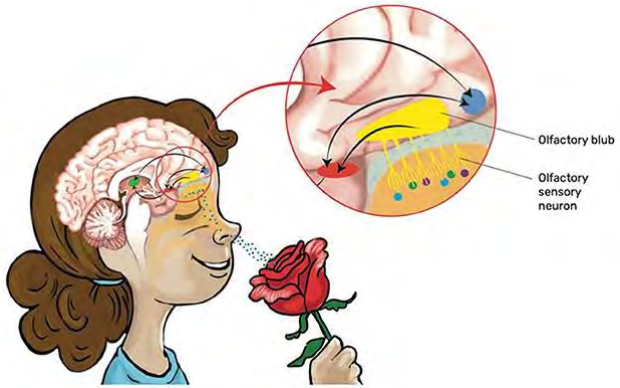
Olfactory Plasticity

- Associate chemicals with danger, food, mates, migration
- Learn toxic foods by olfaction and/or taste
- Mate choice, scent marking
- Maternal bonds
- Emotional learning



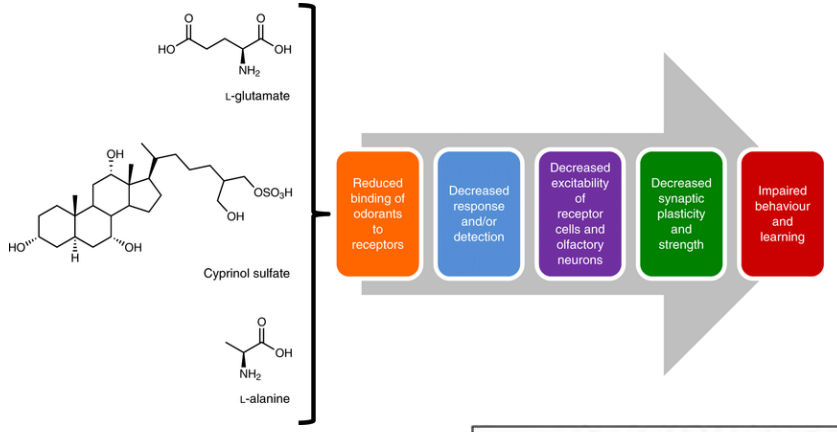




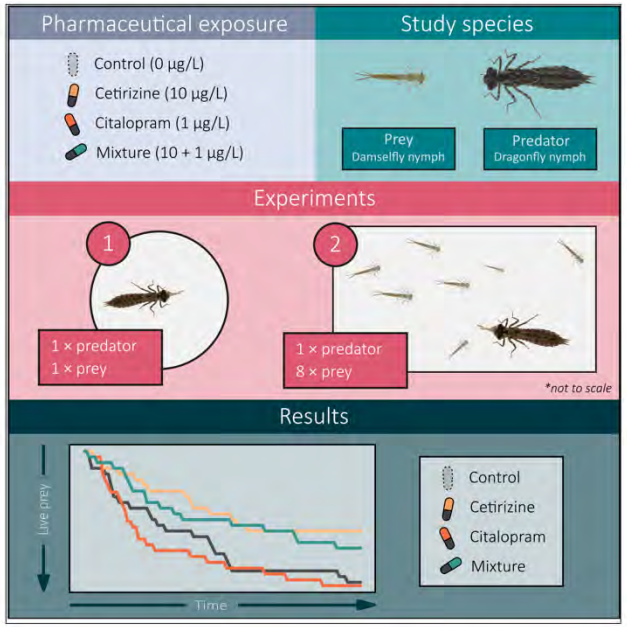


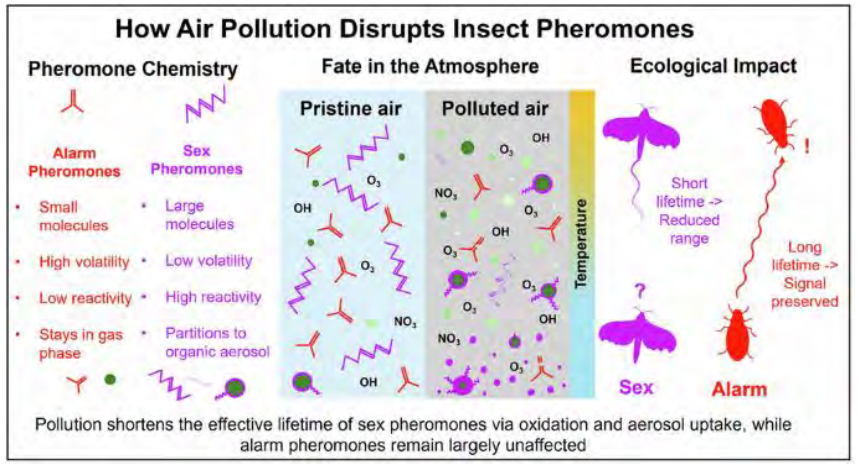
Chemical pollutants affect olfaction/behavior

- Fish: homing, mating, predator/prey
- Insects: predator/prey, mating
- Hearing/chemosensory loss-toxicity



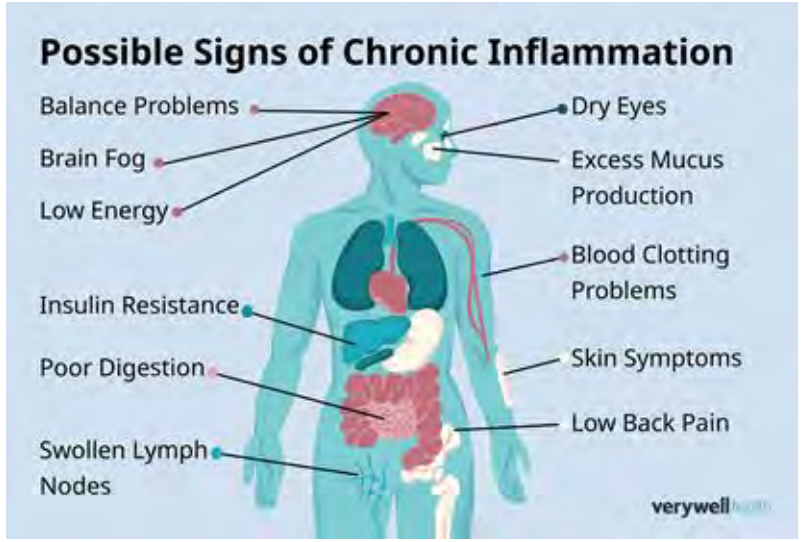


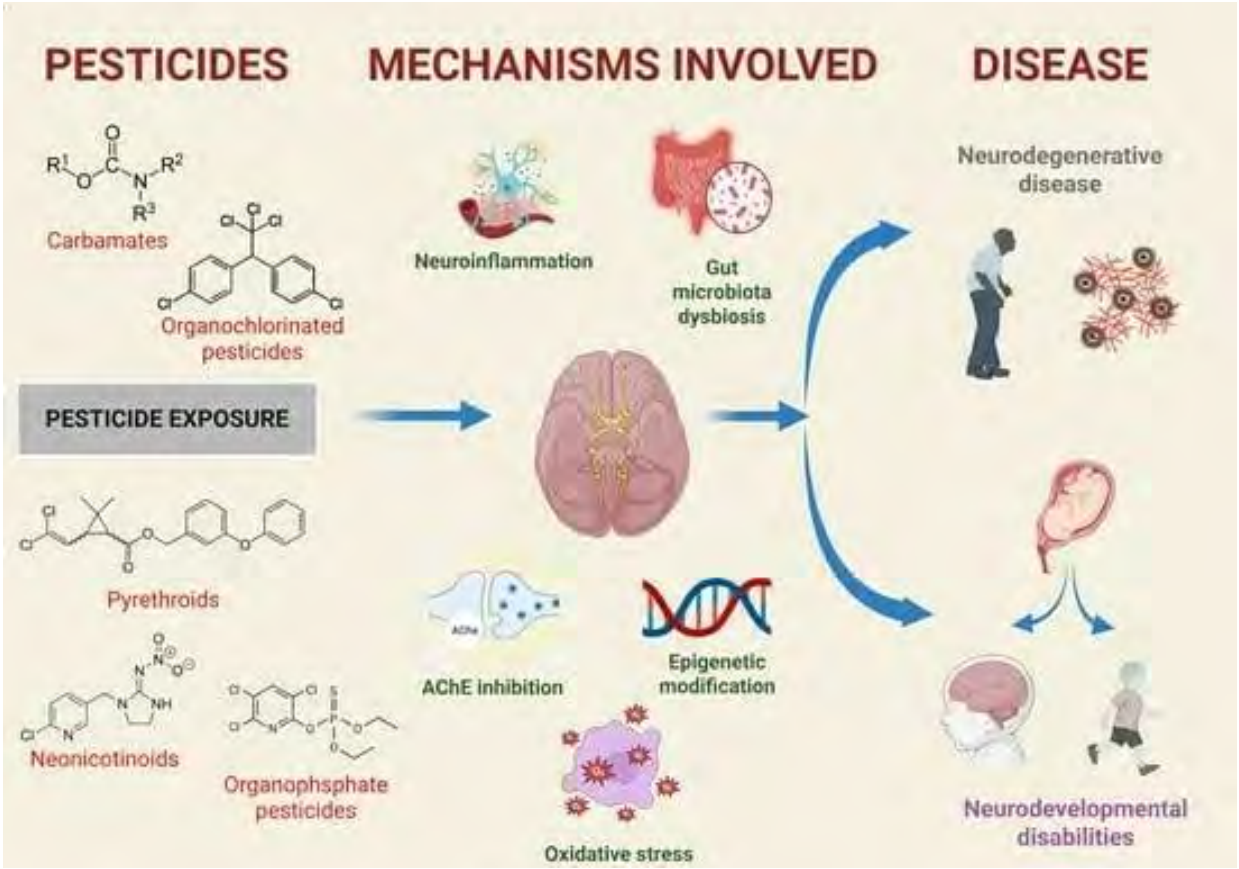




In addition to these direct effects,

- Inflammation
- Immune activation
- Gut-brain-immune interactions
- Developmental effects





Pesticides, PFAs and Reproductive Health



Original Investigation FREE

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Association Between Pesticide Residue Intake From Consumption of Fruits and Vegetables and Pregnancy Outcomes Among Women Undergoing Infertility Treatment With Assisted Reproductive Technology

Yu-Han Chiu, MD, ScD[1,2]; Paige L. Williams, PhD[2,3]; Matthew W. Gillman, MD, SM[4,5]; et al

JAMA Intern Med
Published Online: January 2018
2018;178(1):17-26.
doi:10.1001/jamainternmed.2017.5038

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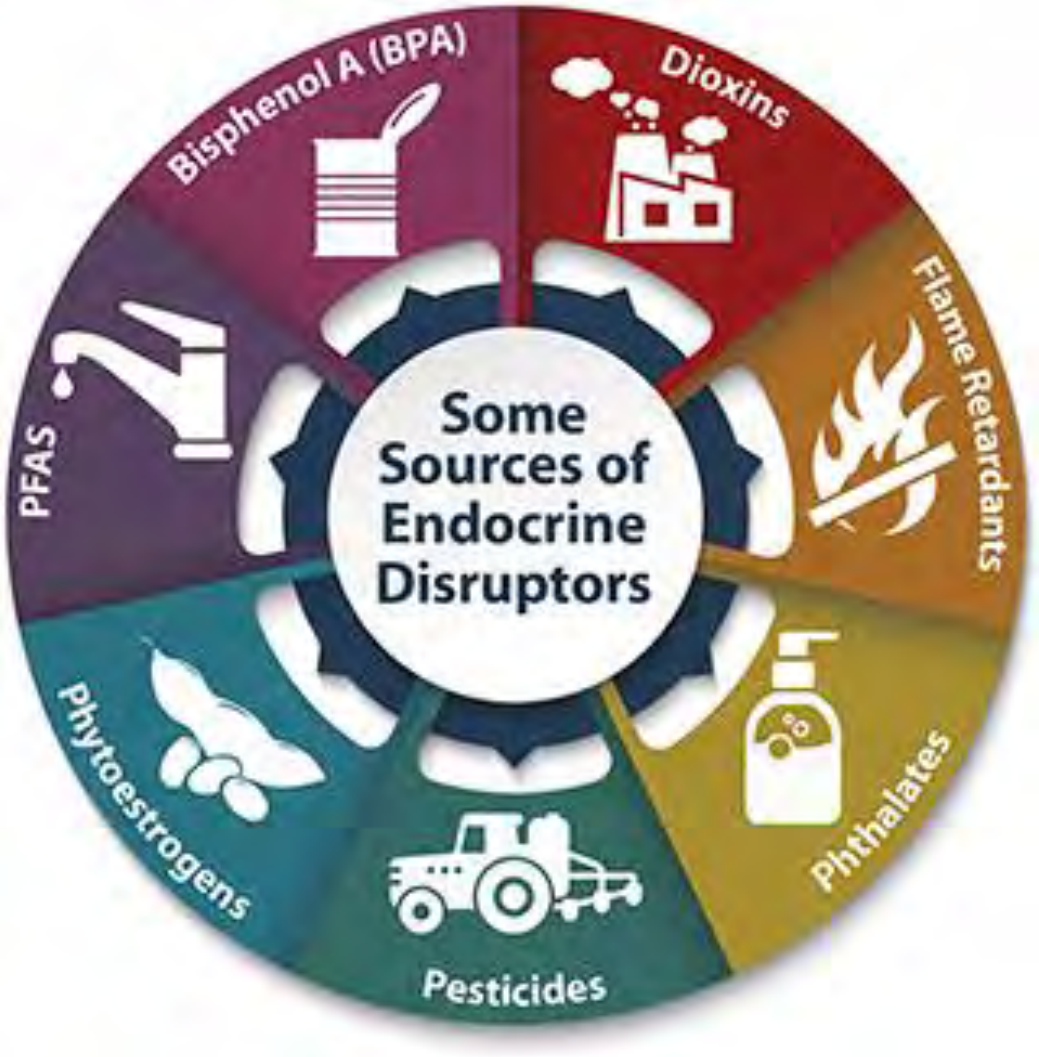
- Reduced fertility
- Increased risk of miscarriage
- Reproductive hormone abnormalities
- Increased risk of birth defects
- Increased risk of learning/developmental disabilities

https://www.ewg.org/

https://www.youtube.com/watch?v=VfYNGZJIlB4

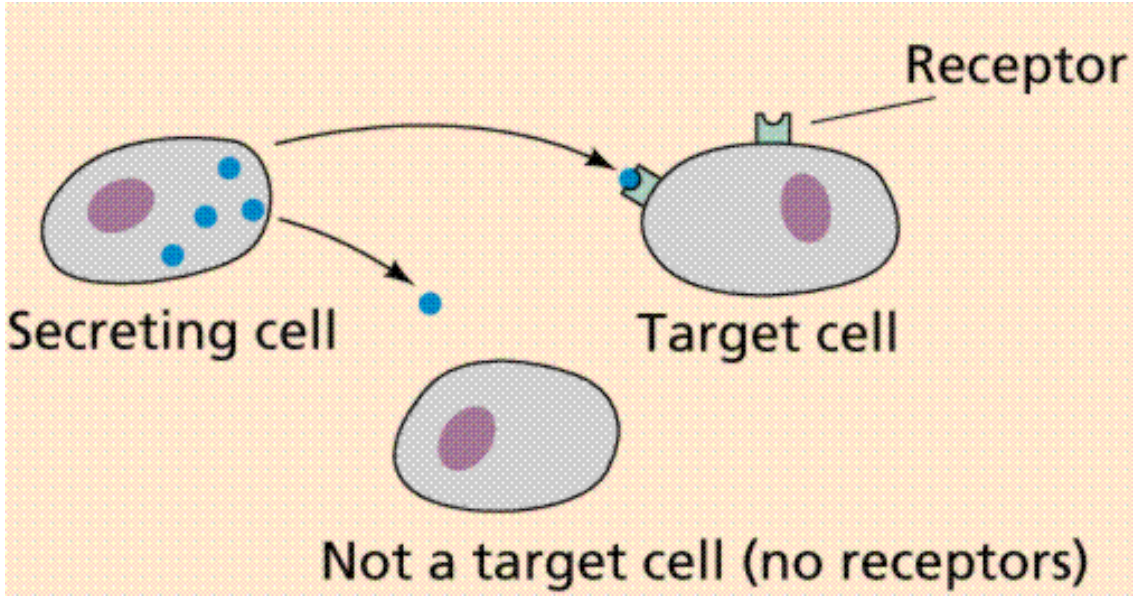
An important mechanism of chronic chemical toxicity

Endocrine Disruption



Endocrine “Systems”

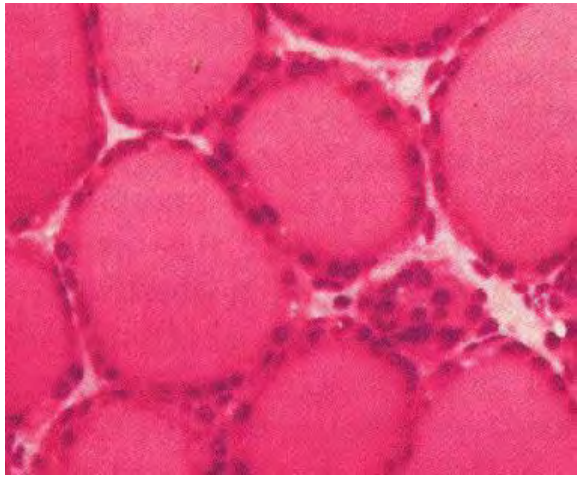
- Endocrine glands secrete hormones into the bloodstream. Many endocrine organs have other functions.
- Hormones interact with target cells
- Specificity determined by receptors.



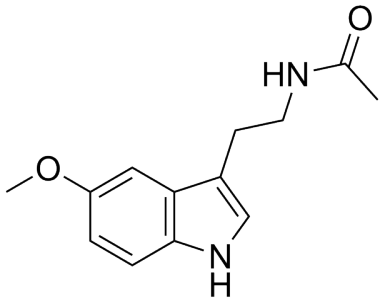
Endocrine “glands”

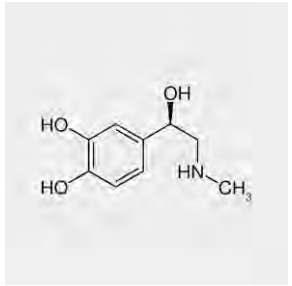
- Hypothalamus
- Pituitary gland
- Pineal gland
- Thyroid gland
- Parathyroid gland
- Adrenal gland
- Pancreas
- Ovary
- Testis

- Liver
- Kidneys
- Adipose
- Heart
- Small intestine
- Stomach
- Thymus
- Skin

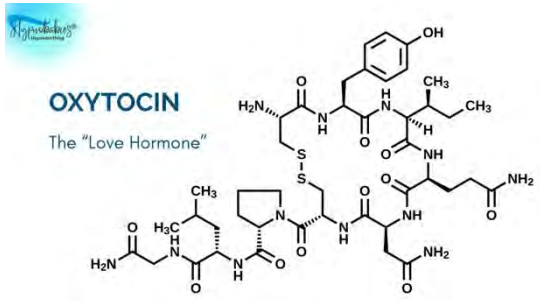


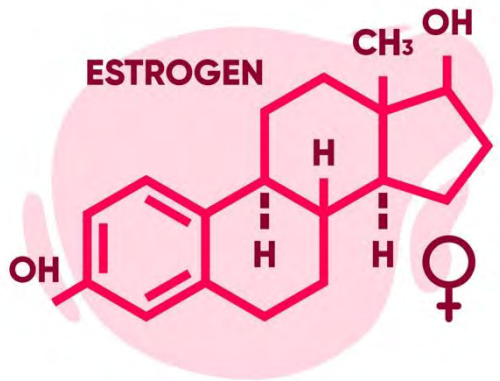
Types of hormones

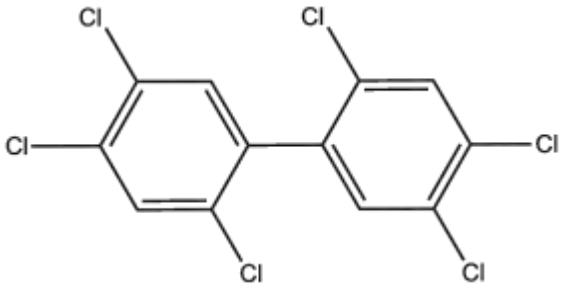


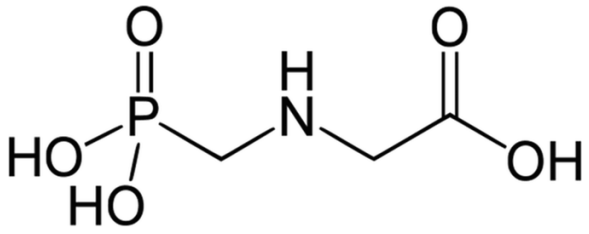


- Amines: Epinephrine (adrenalin), T4/T3, melatonin
- Peptides/proteins: ADH, ANP, insulin, oxytocin, glucagon, ACTH, gastrin, secretin, natriuretic peptide, leptin, ghrelin, prolactin
- Glycoproteins: FSH, LH, erythropoietin
- Steroids: cortisol, testosterone, estrogen, progesterone, aldosterone, vitamin D

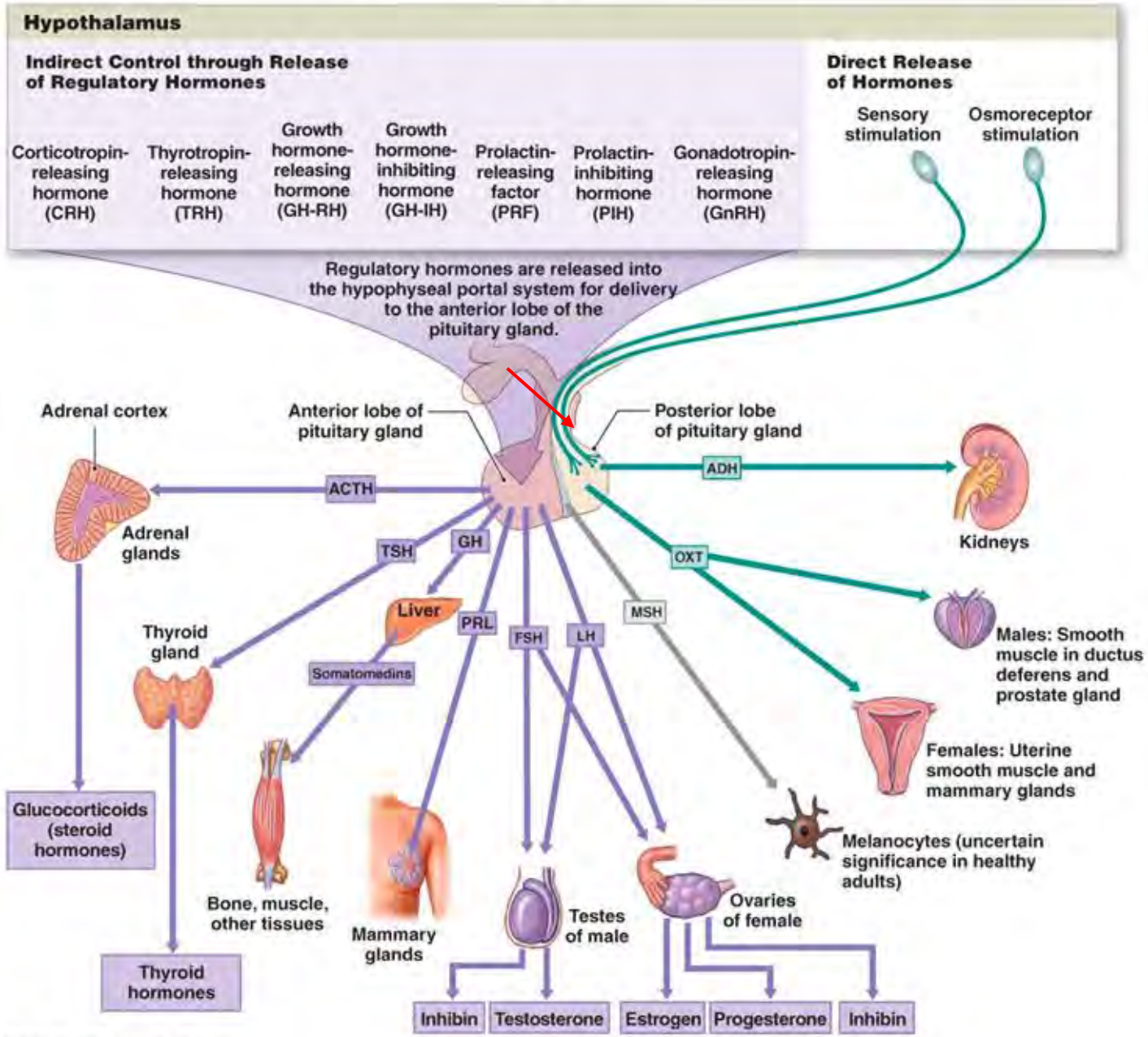






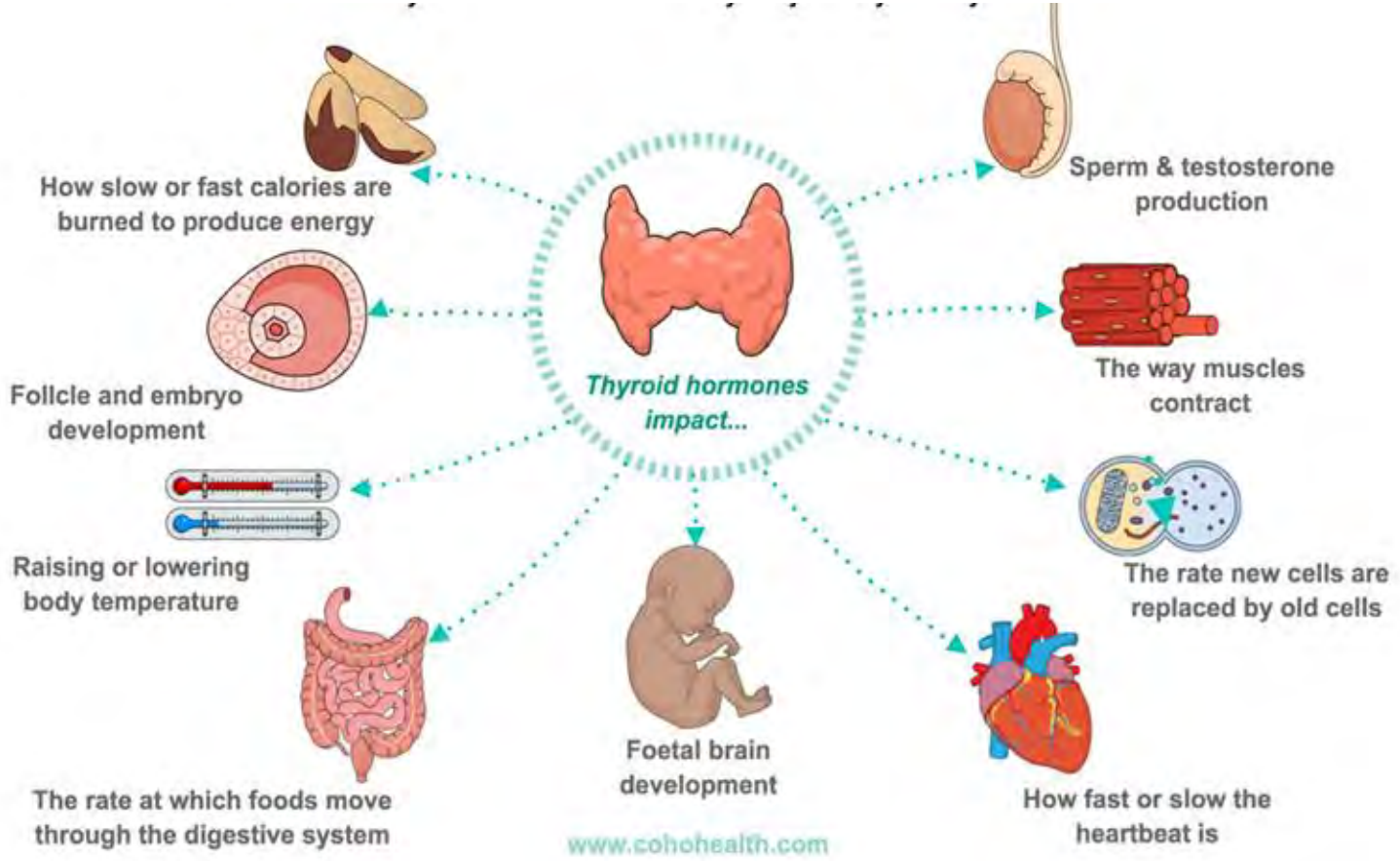


An overview of the relationships between hypothalamic and pituitary hormones, and some effects of pituitary hormones on target tissues

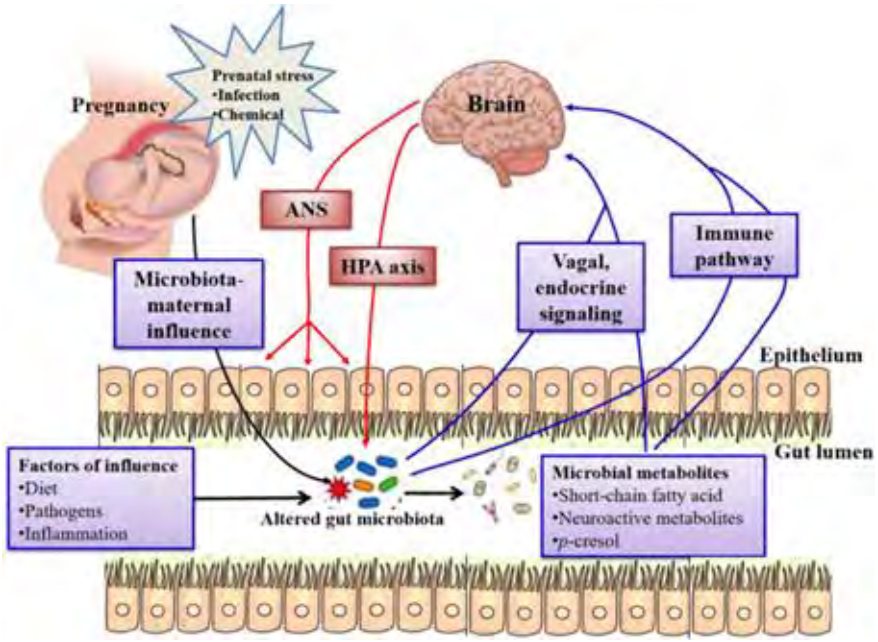


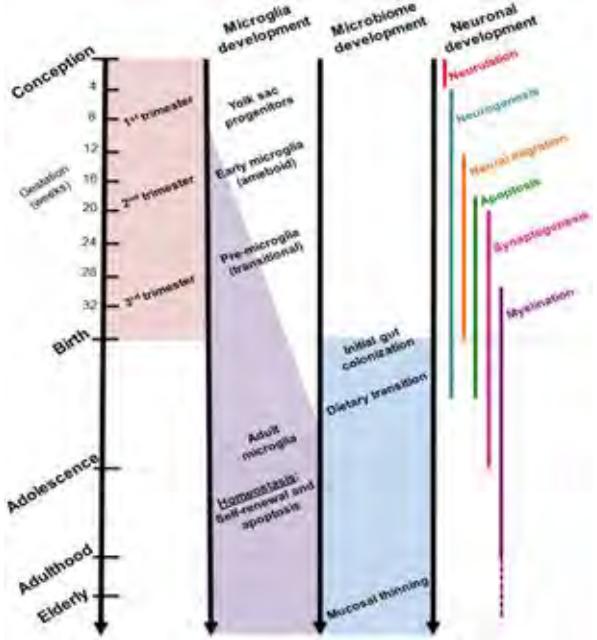
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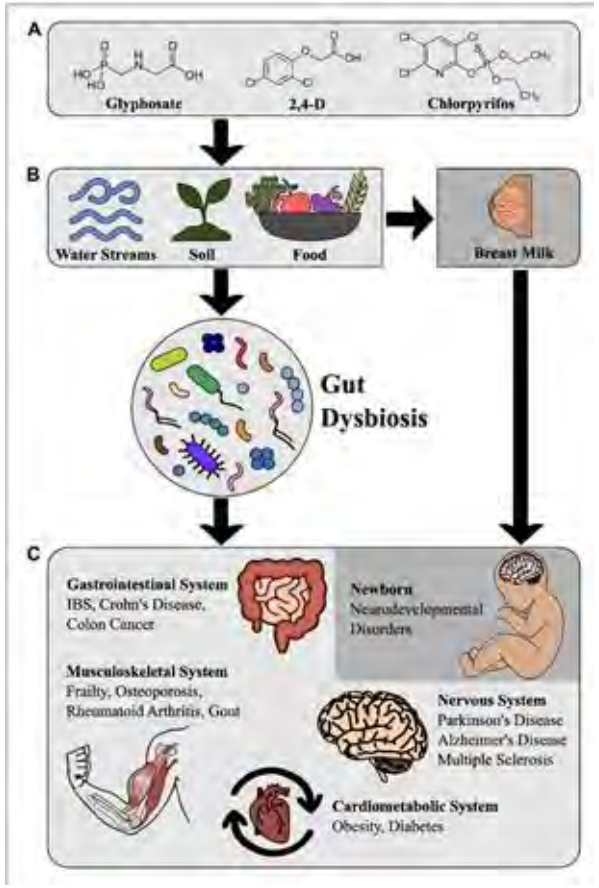
A Key Hormone: Thyroid Hormone



Where and When…..the how





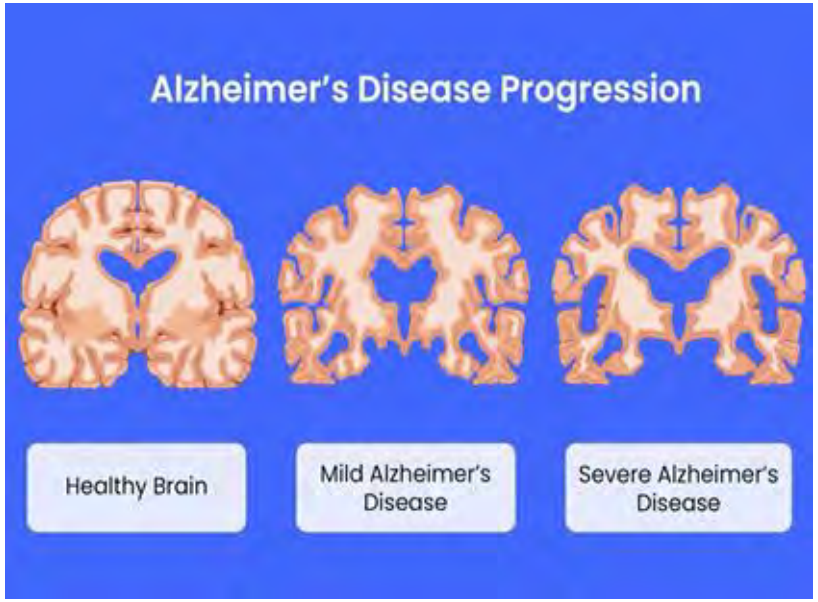


Well-established links to Neurodegenerative disease

- Alzheimer's
- Parkinson's disease (2019 50% inc. risk)
- Developmental cognitive effects



https://neurologysleepcentre.com/blog/what-is-parkinsons-disease/



"Following EPA's 2019 literature review, an updated study of the Agricultural Health Study cohort was published in 2020 that reported no association between paraquat exposure and Parkinson's Disease. " Oct 29, 2026

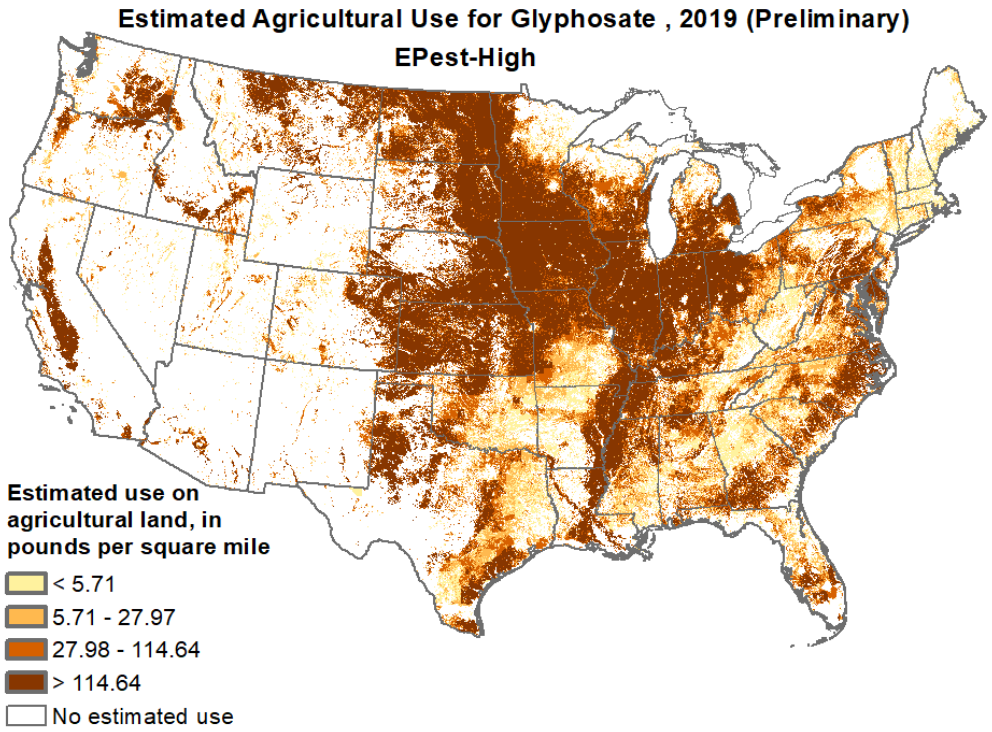
Humans have used pesticides for food cultivation for thousands of years

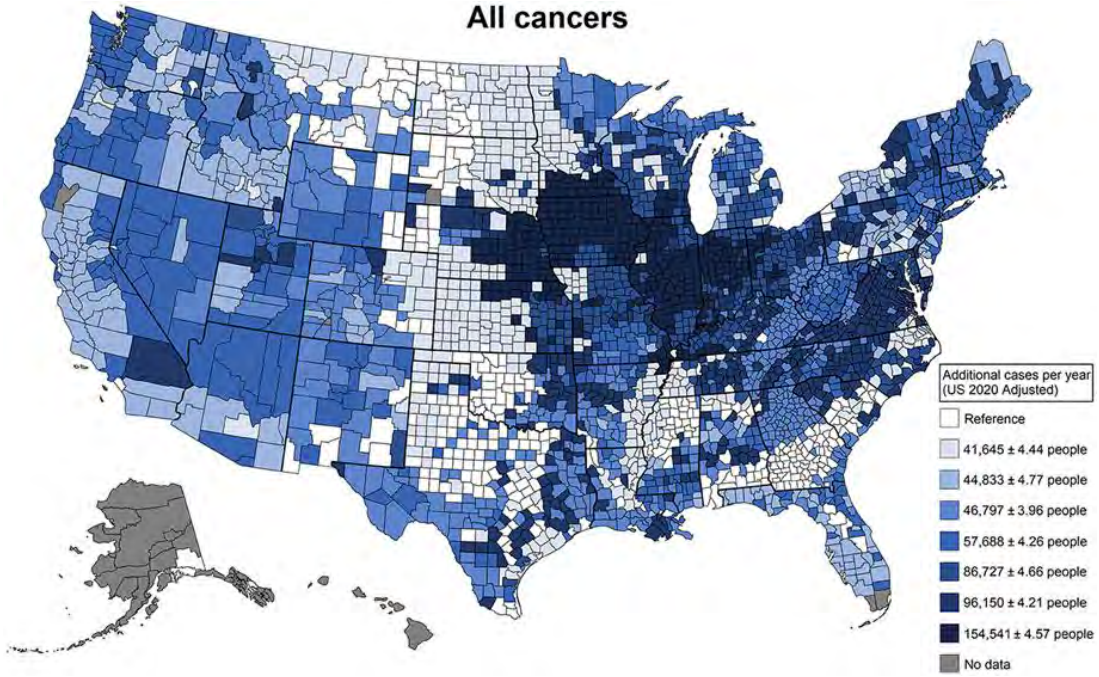
- A sense of urgency that we won't be able to produce sufficient food for the population
- Two approaches: increase productivity (fertilizers)

  reduce competition (pesticides)



US pesticide use- more than 1 billion pounds/year







JAMA Network Open

Original Investigation | Neurology

Proximity to Golf Courses and Risk of Parkinson Disease

Brittany Krzyzanowski, PhD[1]; Aidan F. Mullan, MA[2,5]; E. Ray Dorsey, MD[3] ; et al

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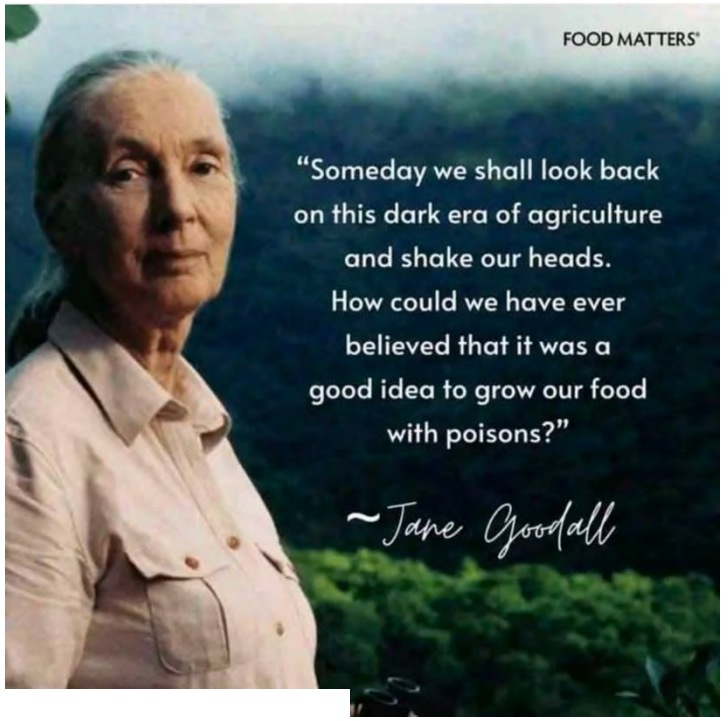
Key Points

Question Does living within proximity to a golf course affect the risk of Parkinson disease (PD)?

Findings This case-control study found the greatest risk of PD within 1 to 3 miles of a golf course, and that this risk generally decreased with distance. Effect sizes were largest in wa-

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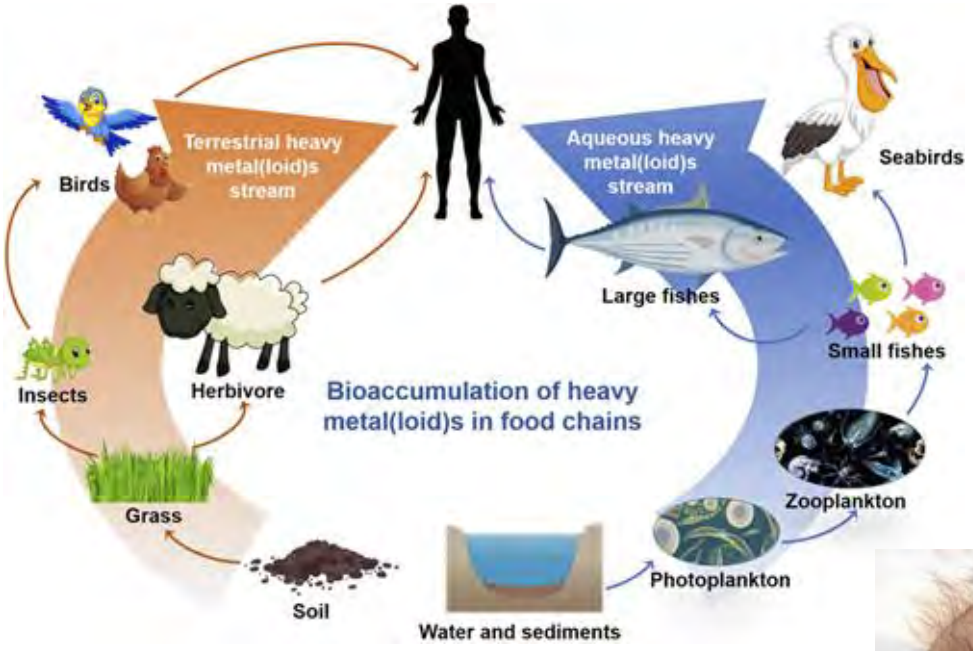
CBS Mornings

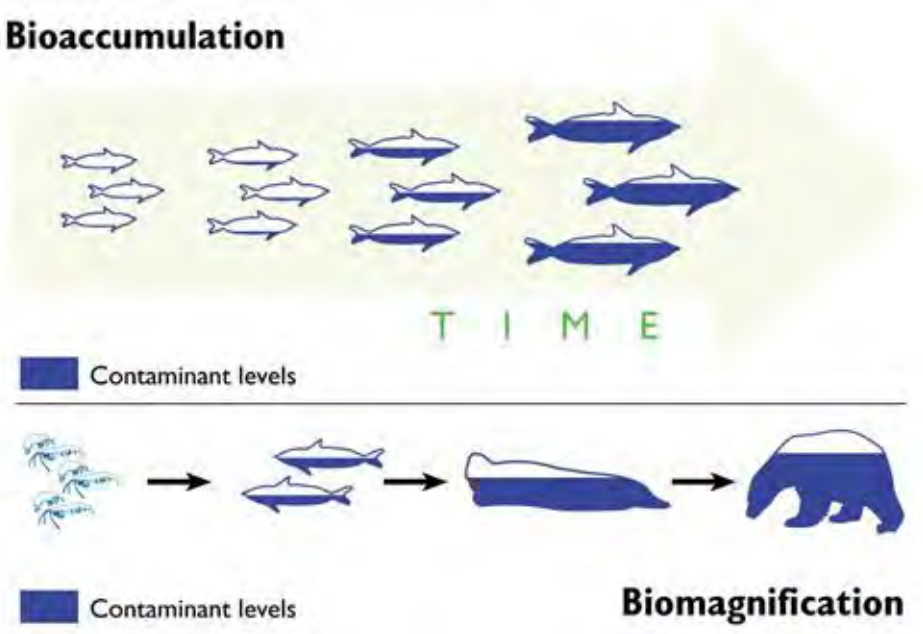
Lawn chemicals can stay in body for "years, even decades"

July 25, 2014 / 7:16 AM EDT / CBS News

Bioaccumulation and Biomagnification

- Bioaccumulation: chemical builds up in organism over time
- Biomagnification: up the food chain







Some disturbing findings

- Of the 30 commonly used lawn pesticides: 22 are toxic to birds, 14 are toxic to mammals, 30 are toxic to fish and aquatic organisms, and 29 are deadly to bees
- Lawn and garden pesticides are deadly to nontarget species and can harm beneficial insects and soil microorganisms essential to a naturally healthy lawn
- Half of shallow wells within the U.S. have detectable levels of pesticides, while 20% of private wells contain at least one contaminant at levels of potential health concern
- In addition to harming pollinators, neonicotinoid contamination has been detected in rivers, lakes, and streams in 29 states, at levels that can result in detrimental effects to keystone aquatic organisms and the entire aquatic food web
- Runoff from synthetic chemical fertilizers pollutes streams and lakes and causes algae blooms, depleted oxygen and damage to aquatic life

How to protect yourself from environmental chemicals

- Avoid plastic that’s in contact with food/drink
- Avoid chemically treated upholstery, clothing, etc.
- Wear a mask on “bad air” days- pollution from traffic
- Drive an EV, take mass transit
- Be vigilant about chemical pollution sources in your town
- VOTE, Be Active in Your Town

Steps you can take

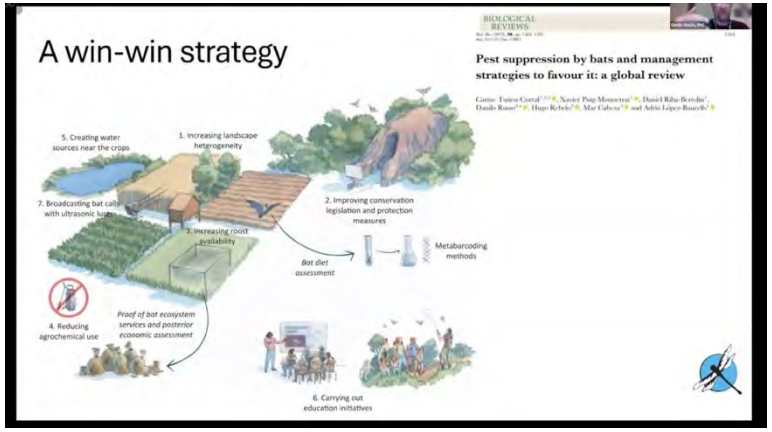
- Don’t use pesticides and tell everyone you know
- Reduce the size of your lawn of grass
- Replace your grass with a diversity of plants- clovers, creeping thyme….
- Bring up concerns to local governments….support efforts to preserve environment, conservation
- Buy organic food, especially local
- VOTE

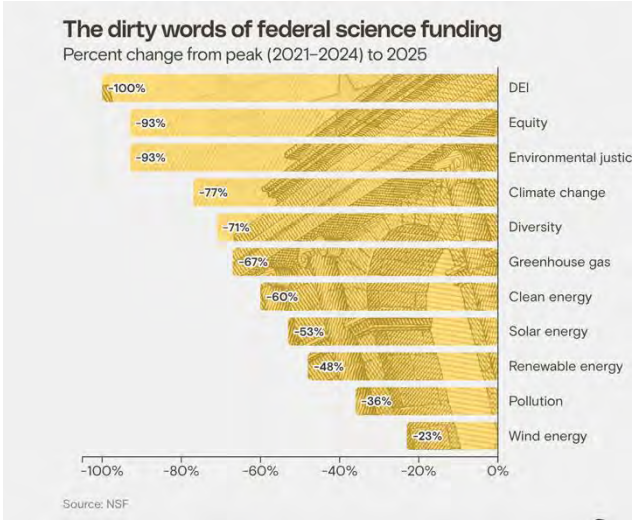
Steps to take

- To help others: community awareness, vote
- To help yourself: organic (ROP), reduce plastic (utensils, nonstick pans, storage)
- Lawn care changes

"There are no passengers on Spaceship Earth. We are all crew."

- Philosopher Marshall McLuhan





A new financial paradigm is required

Where:

- the true value all living things is recognised, in a global account of living biomass
- the full cost of greenhouse gas emissions is calculated and not subsidised
- only sustainable growth that does not deplete biosphere resources, is recognised
- finite resources are fully recycled
- the value of people's work is fairly recognised, especially in respect of biosphere maintenance

For further reading/learning!

- Subscribe to my Modern Marinade newsletter: https://earthmoves.vassarspaces.net/
- Beyond Pesticides website: https://www.beyondpesticides.org/
- Pesticides and Europe: https://www.eea.europa.eu/en/analysis/publications/how-pesticides-impact-human-health
- Clean and Healthy NY: https://cleanandhealthy.org/

Next week:

- https://www.youtube.com/watch?v=migcZPUDyeM
- https://youtu.be/MmvupyKPF_0
- https://www.youtube.com/watch?v=XX4P4XDtVB0
- https://www.youtube.com/watch?v=1bwvQ0lsMQc