Dioxins & Incineration

Dr Paul Connett

Professor Emeritus of Chemistry

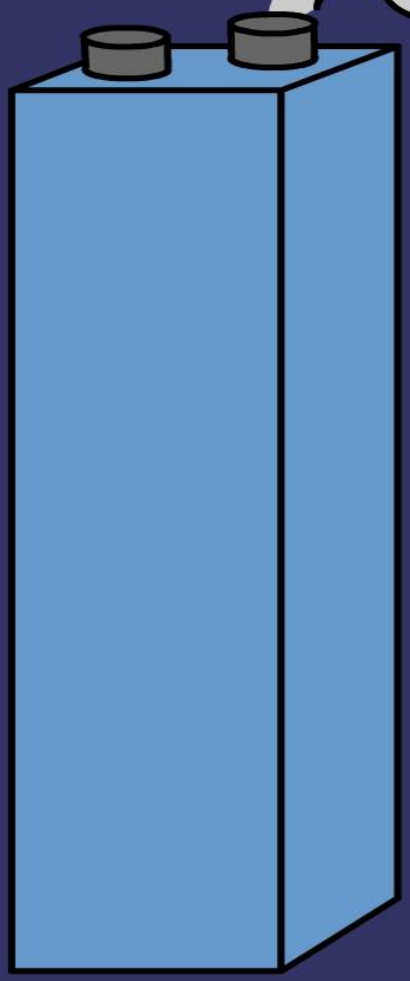
St Lawrence University, Canton, NY

Paul@AmericanHealthStudies.org

OUTLINE

- Dioxins & incineration:
- A) history
- B) chemistry
- C) biology
- D) health threat

AIR EMISSIONS



- CO2 + H2O
- ACID GASES:
  HCl, HF, SO_2
  NO_x
- TOXIC METALS:
  Pb, Cd, Hg, As, Cr etc
- NEW COMPOUNDS:
  PCB's
  PCDDs (DIOXINS)
  PCDFs (FURANS)
  ETC

NANO PARTICLES

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- 1985 - Ozvacic et al. find dioxins formed after the furnace.

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- 1990's better dioxin control from incineration. Many plants retrofitted and older plants closed down.

DIOXINS
The chemical structures

Dioxin like compounds (DLC)

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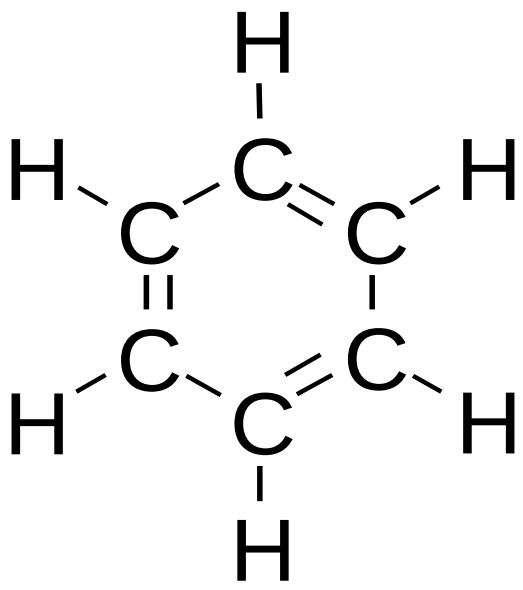
- PCDDs (dioxins)

Benzene



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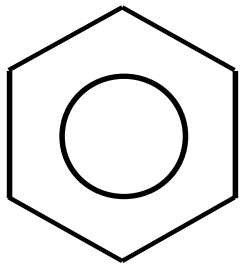
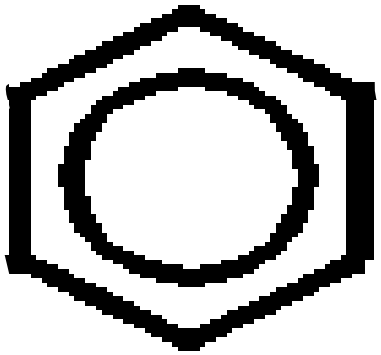
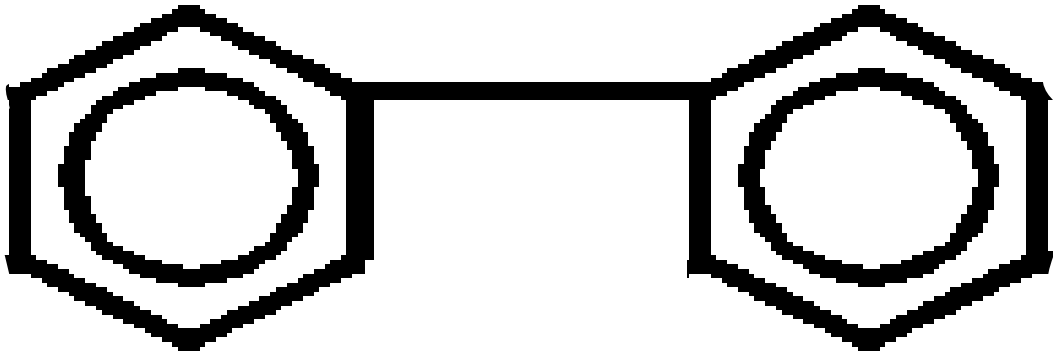


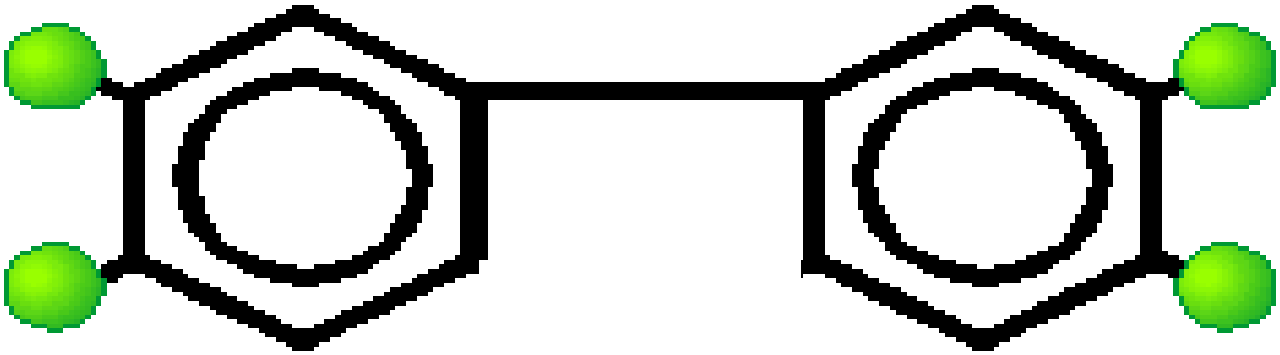
C_6H_6



BENZENE

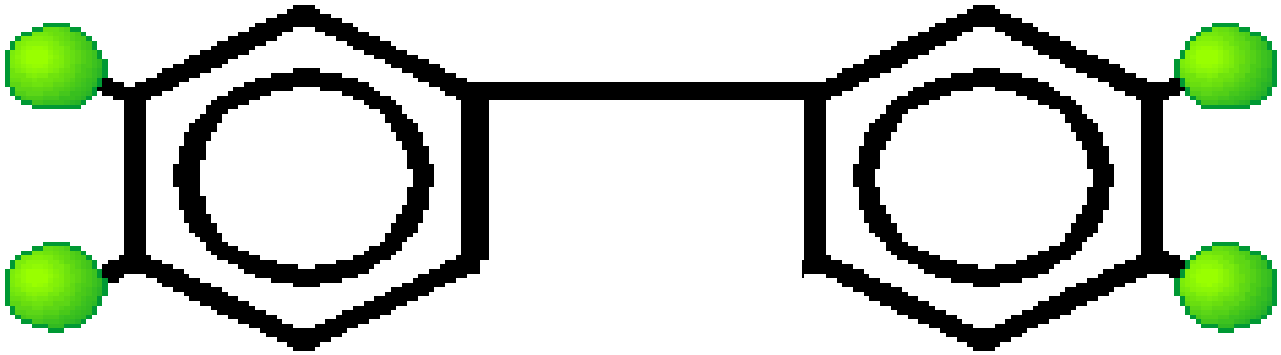


BIPHENYL



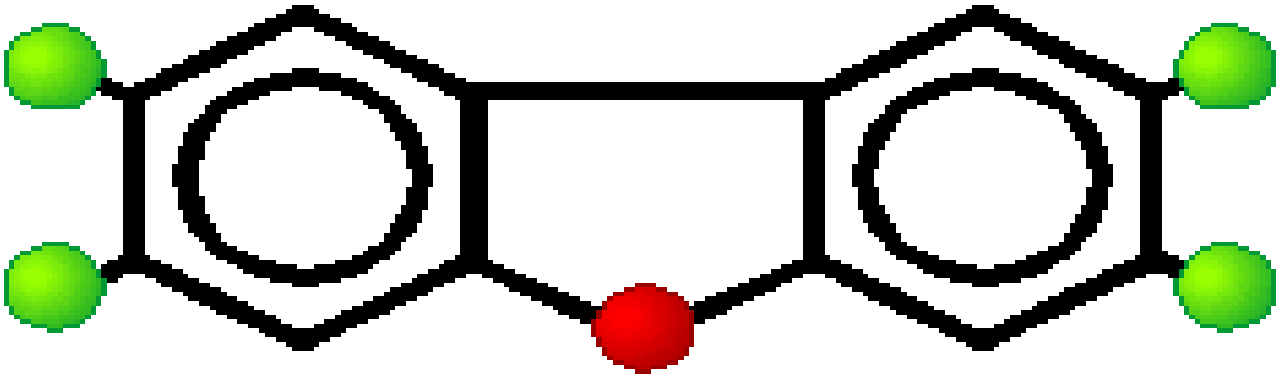
One of 209 PCBS

Polychlorinated biphenyls



One of 209 PCBS

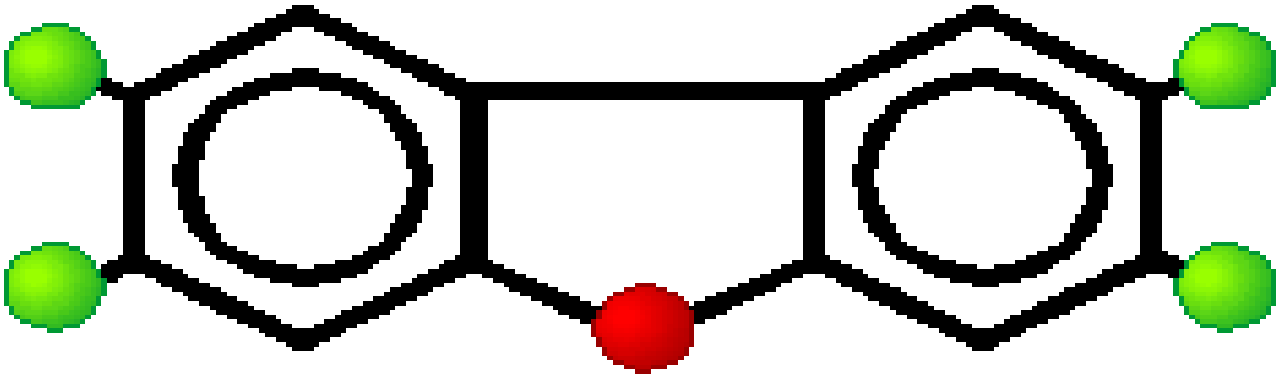
PCBs = a family of compounds in which chlorine atoms are substituted for hydrogen at 1 to 10 positions of BIPHENYL .



2,3,7,8-TetraCDF

Furans (or PCDFs) have an oxygen atom forming a five membered ring (the furan) between the two benzenes of PCBs. There are 135 furans.

Furans (or PCDFs)



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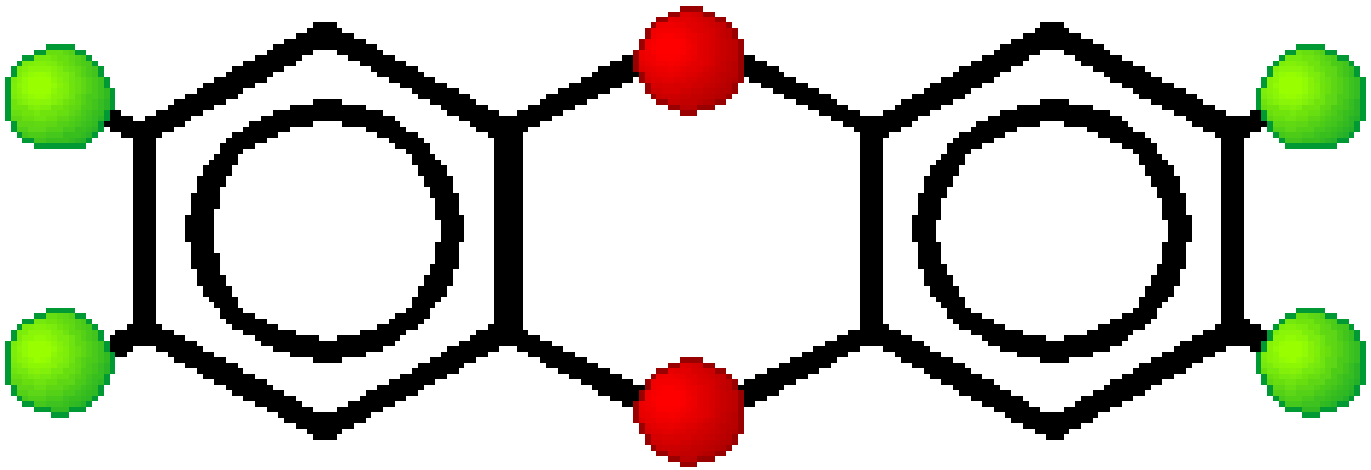

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Dioxins (or PCDDs) have two oxygen atoms linking the two benzene rings, forming the dioxin ring. There are 75 dioxins.

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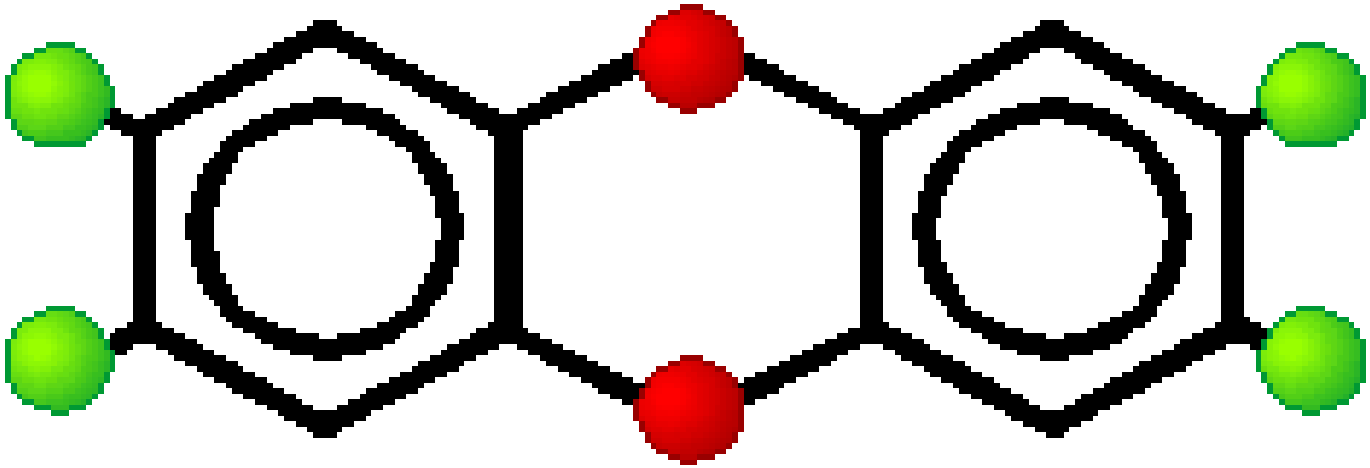

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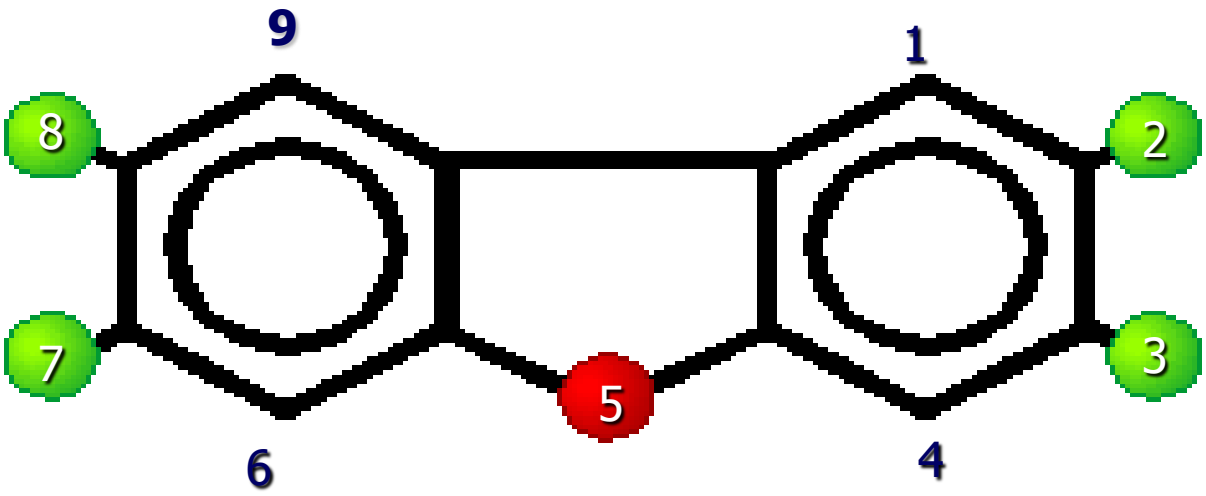
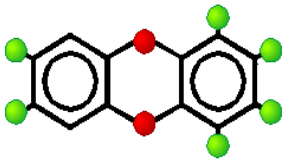


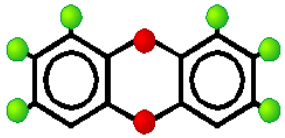
2,3,7,8-TetraCDF

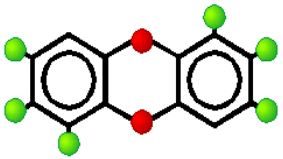
2,3,7,8-TETRA CHLORO DIBENZO FURAN

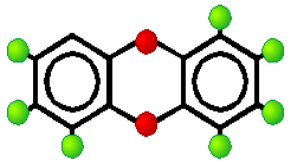
There are 17 extremely toxic dioxins and furans. They have chlorine at the 2,3,7 and 8 positions:

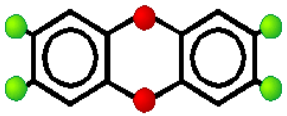
7 Dioxins **and** **10 Furans**

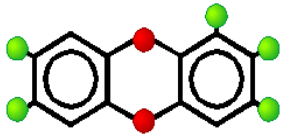

1,2,3,4,7,8-HexaCDD

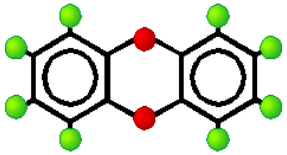

1,2,3,7,8,9-HexaCDD

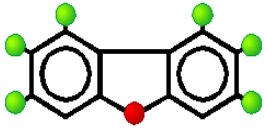

1,2,3,6,7,8-HexaCDD

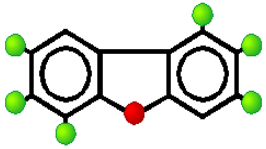

1,2,3,4,6,7,8-HeptaCDD

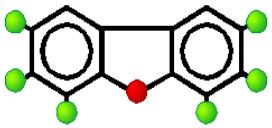

2,3,7,8-TetraCDD

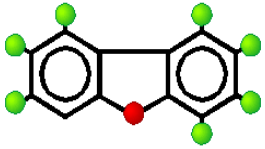

1,2,3,7,8-PentaCDD


OctaCDD


1,2,3,7,8,9-HexaCDF


1,2,3,6,7,8-HexaCDF


2,3,4,6,7,8-HexaCDF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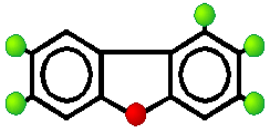
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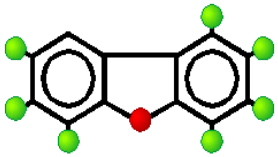
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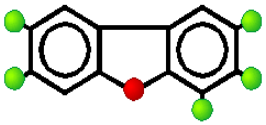
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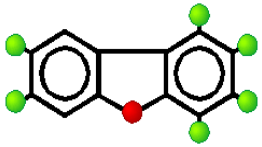
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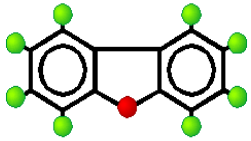
OctaCDF

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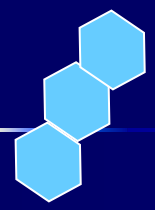
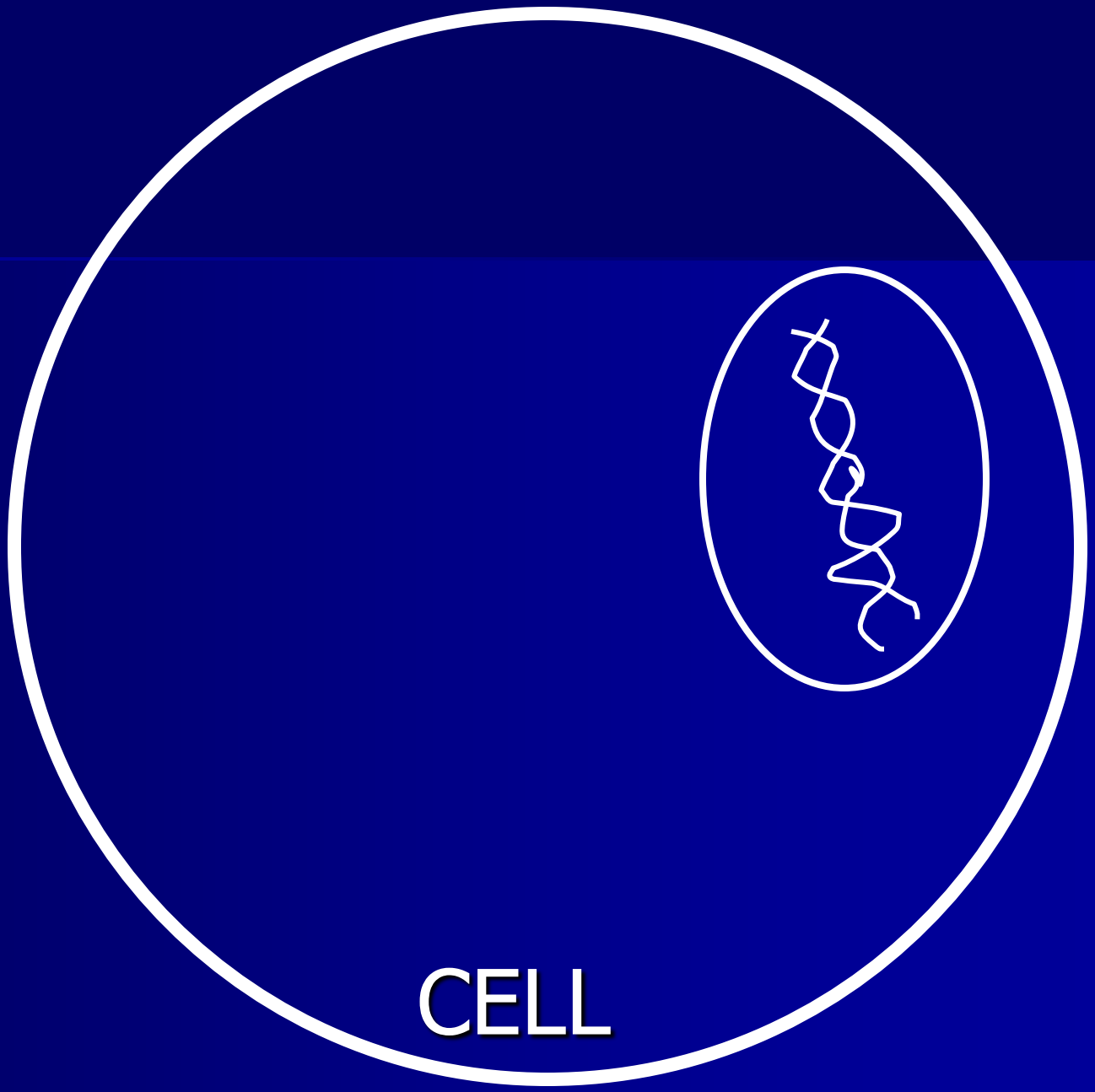
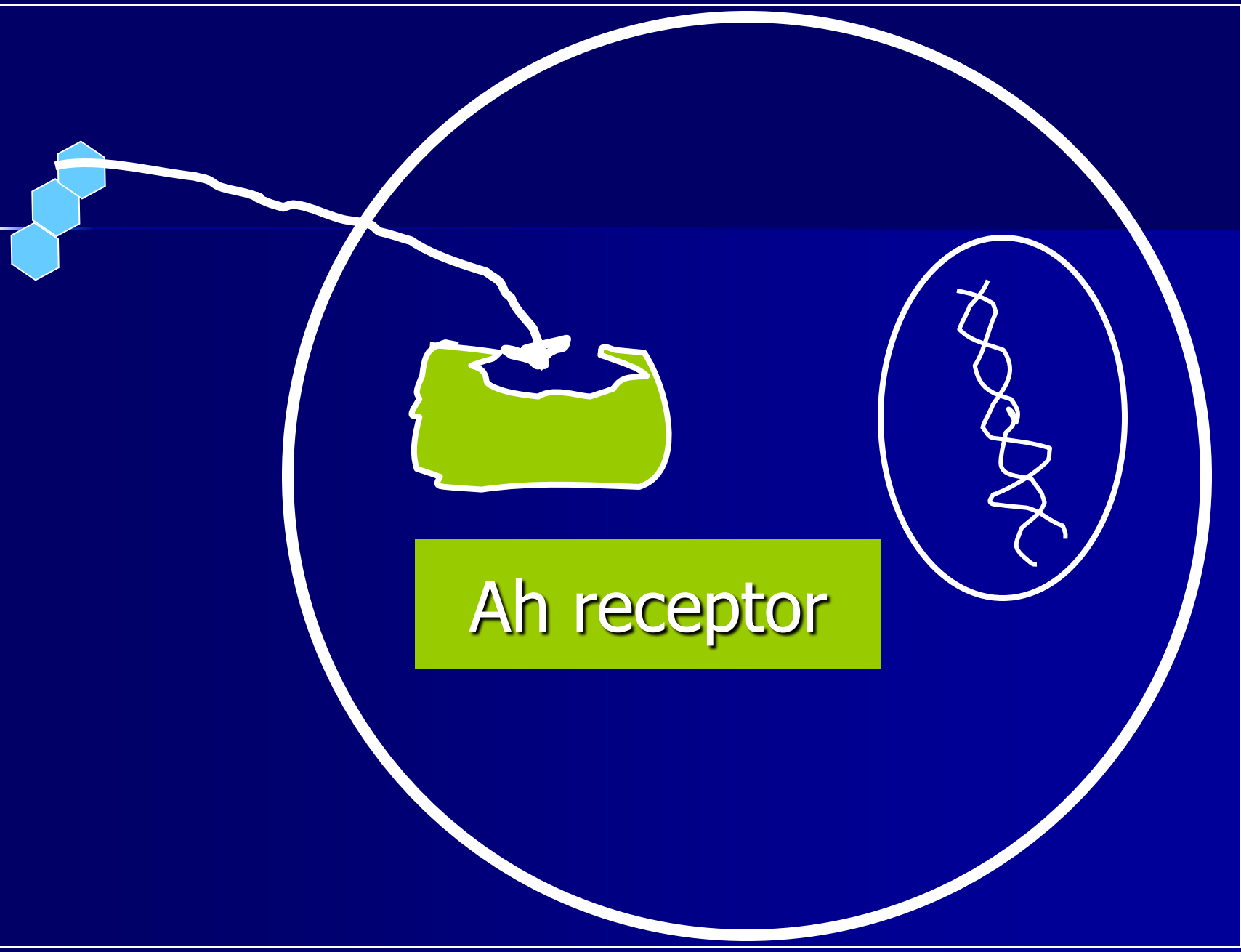
- Nitrogen and sulfur analogues!

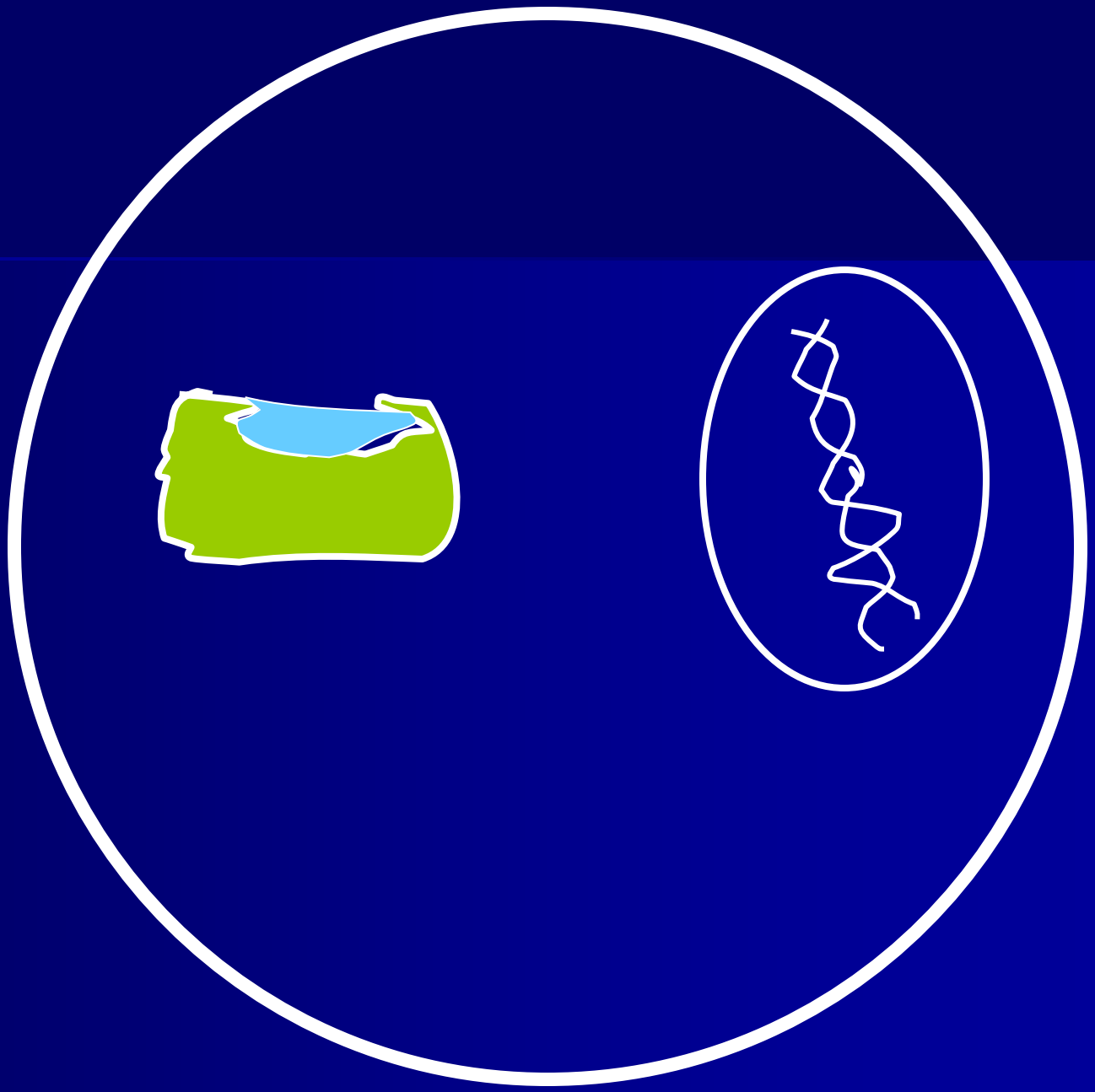
The biology

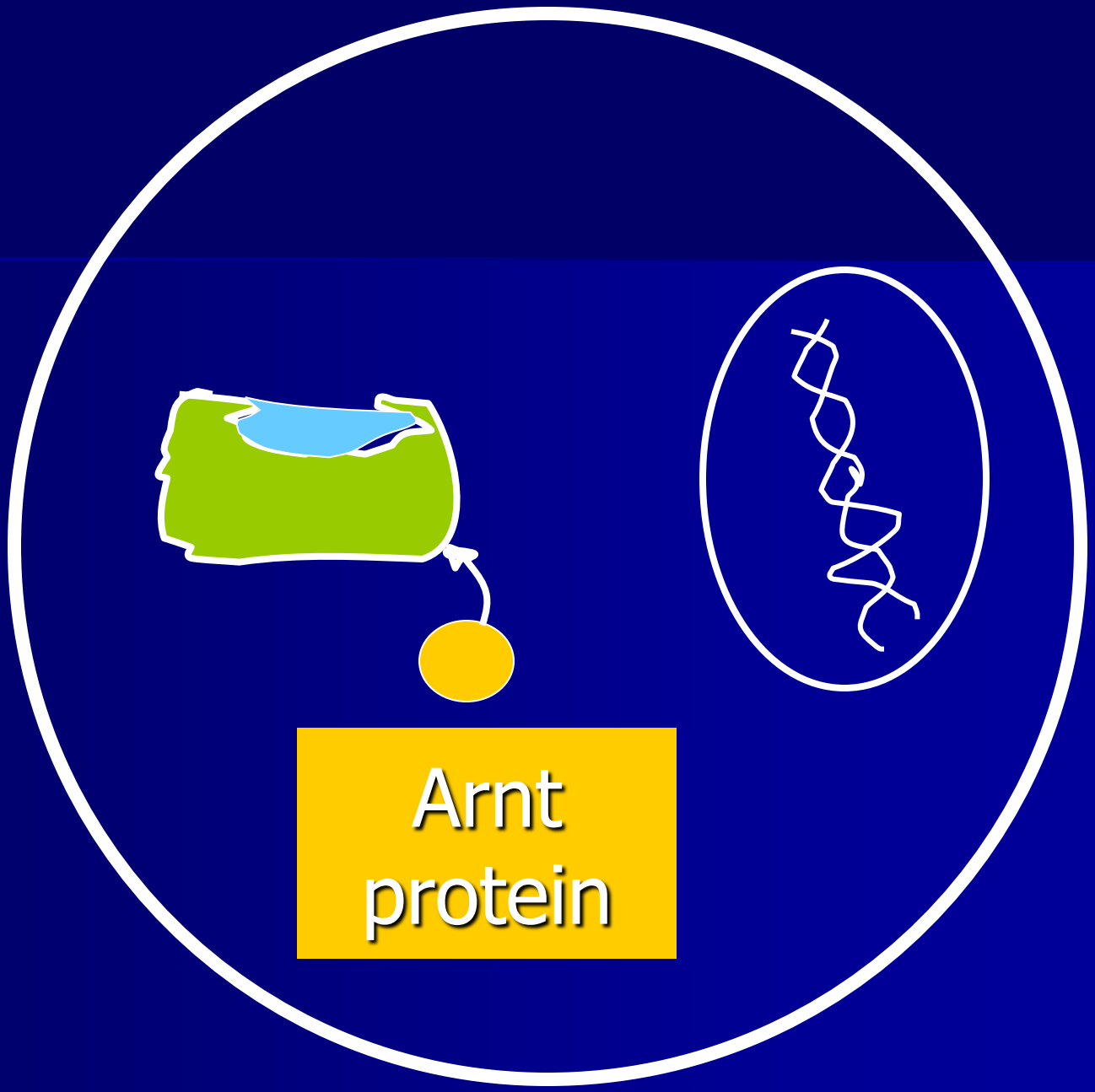


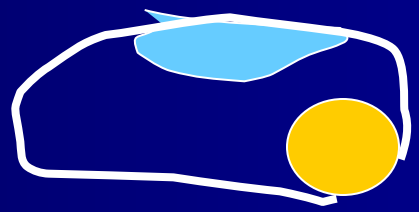
Dioxin
Or
Dioxin-like
Compound
(DLC)

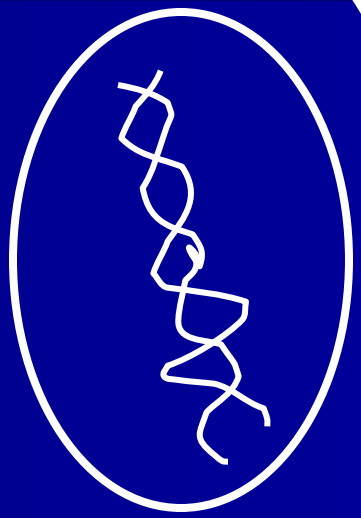



Ah receptor

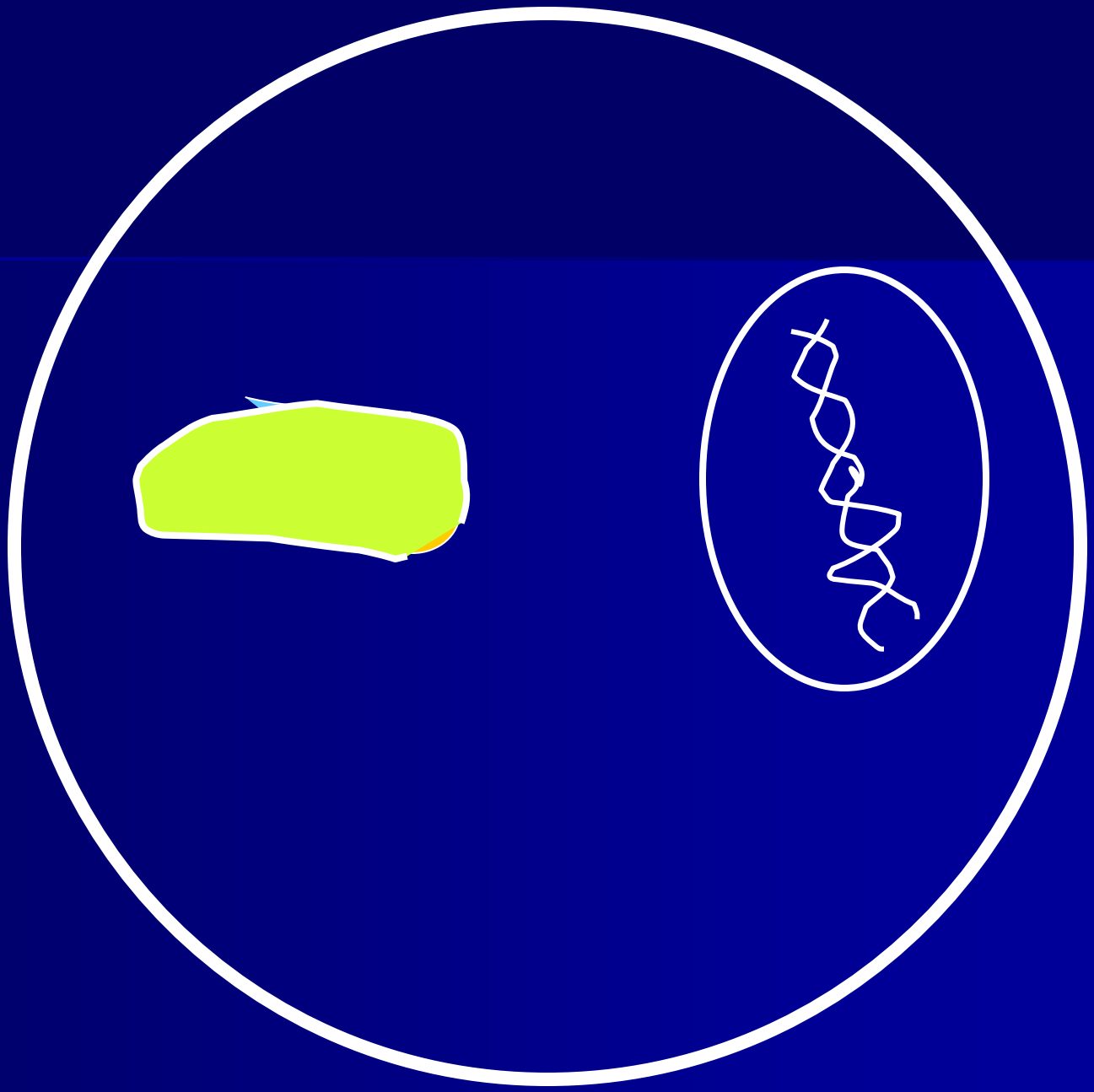


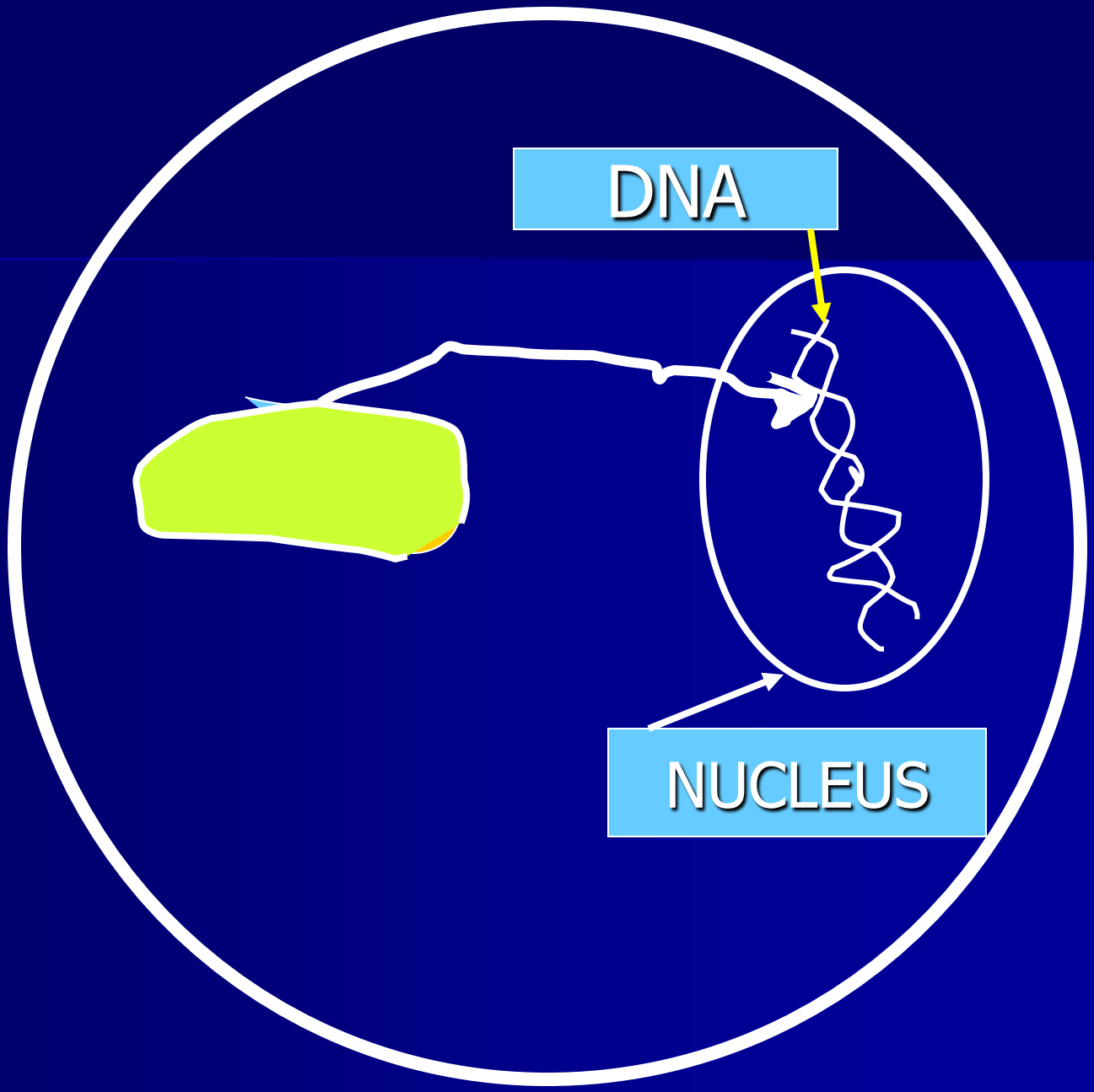

Arnt
protein



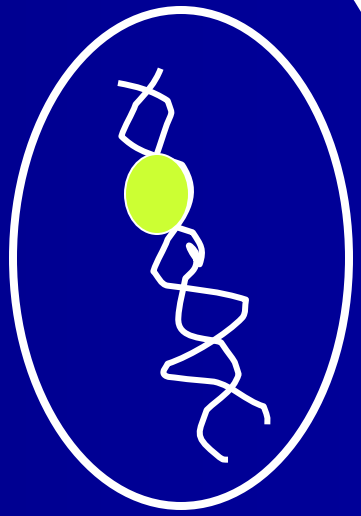


Complex
With
Changed shape

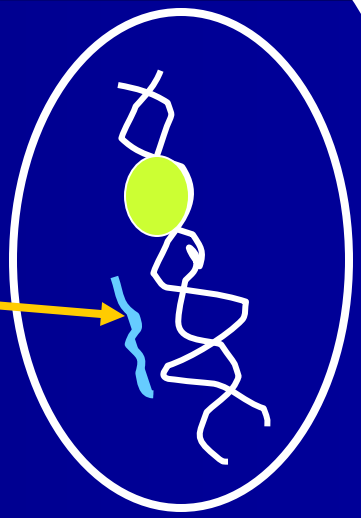



DNA
NUCLEUS

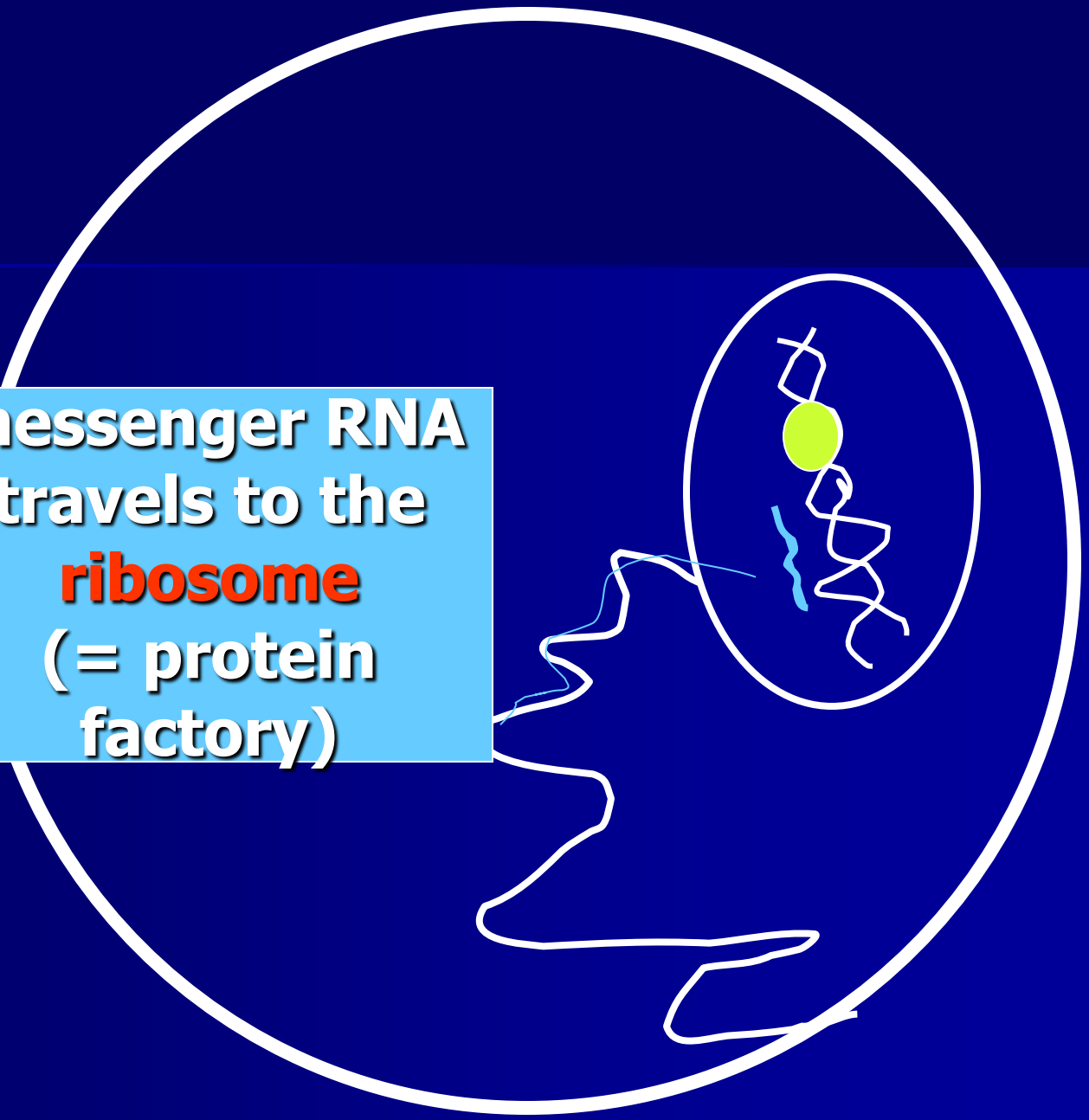
Dioxins
do not cause
mutations
But
switch on genes



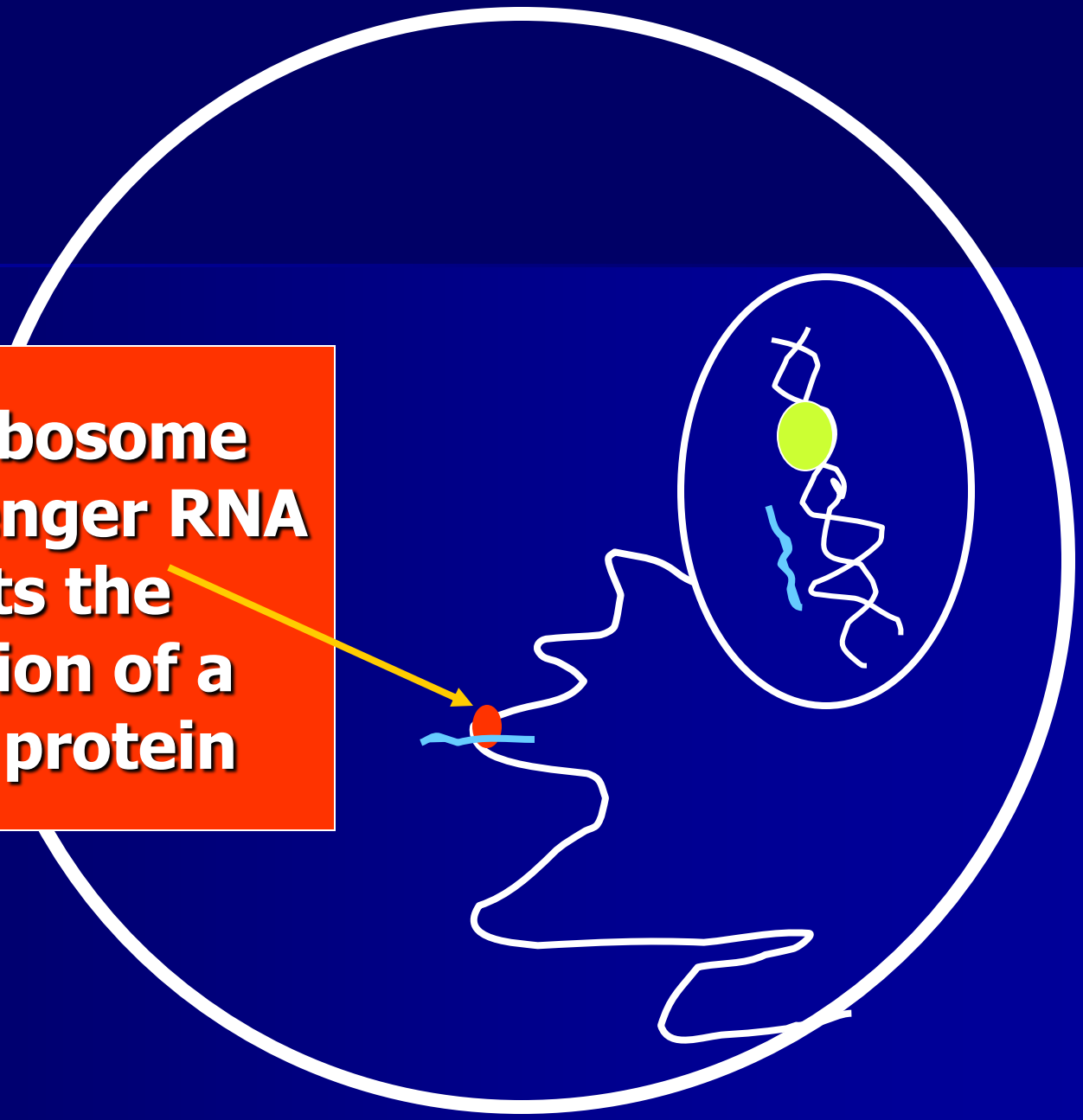
Switching on a gene means producing a specific messenger RNA which codes for a specific protein

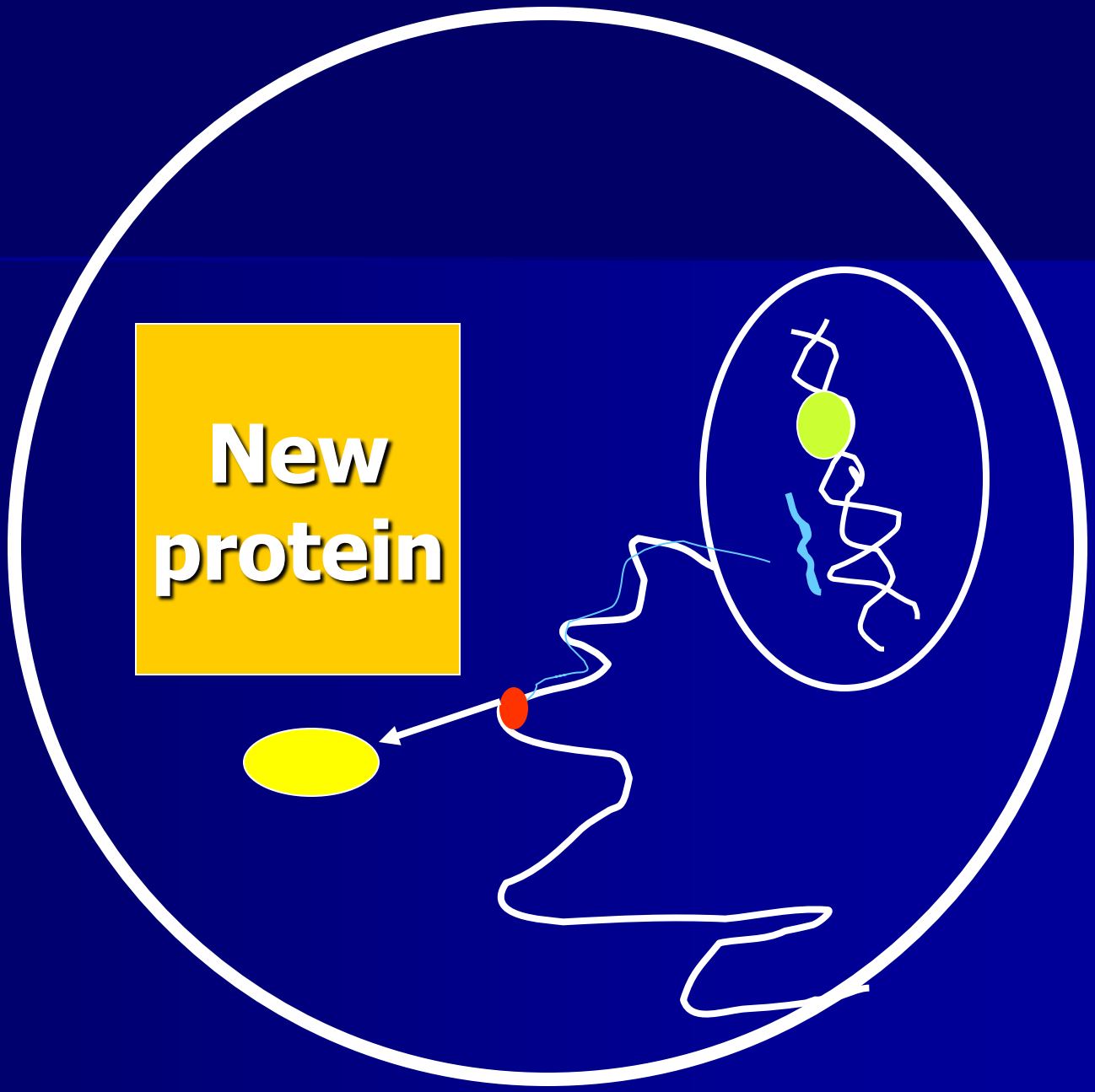


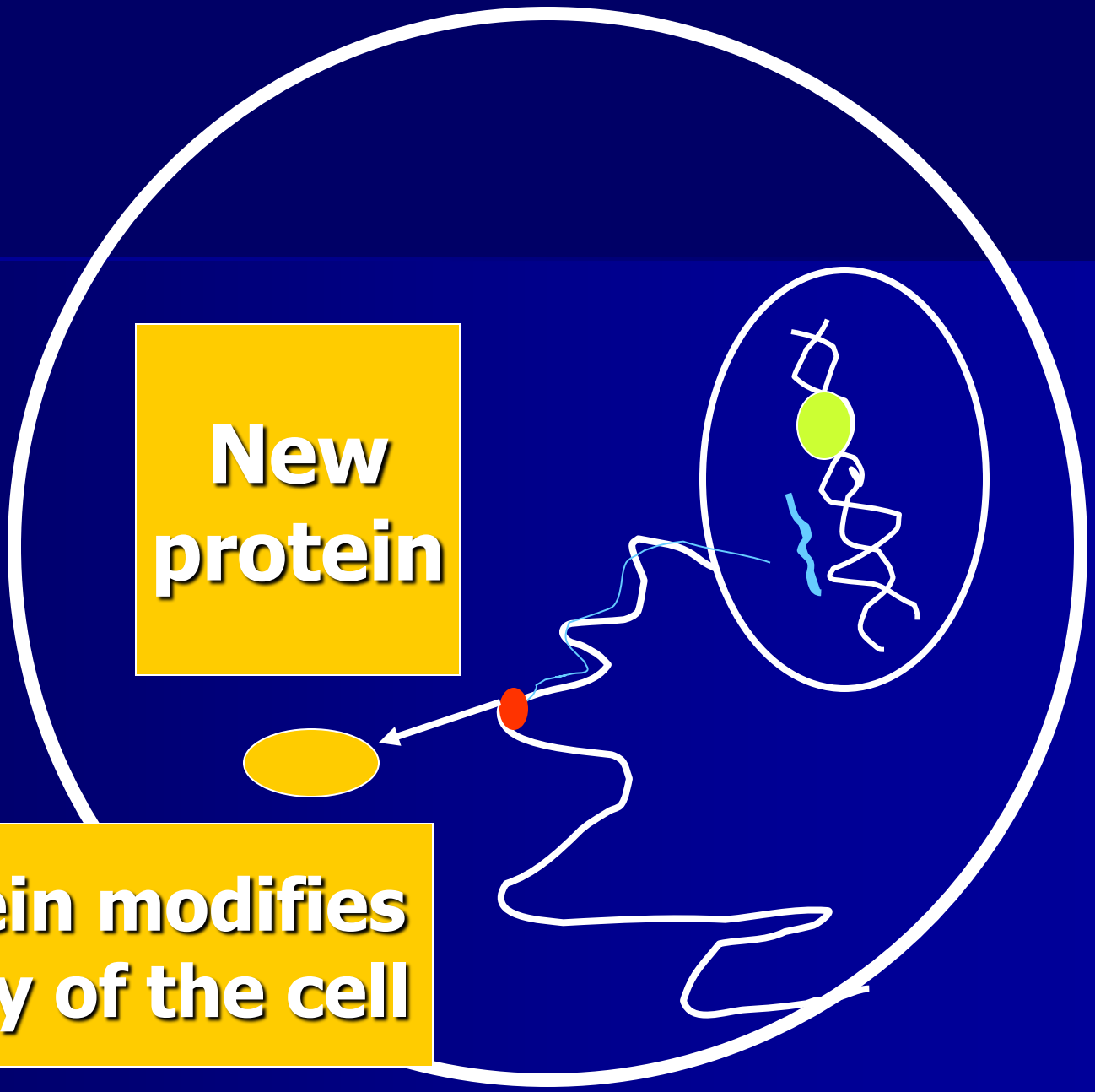
messenger RNA travels to the **ribosome** (= protein factory)



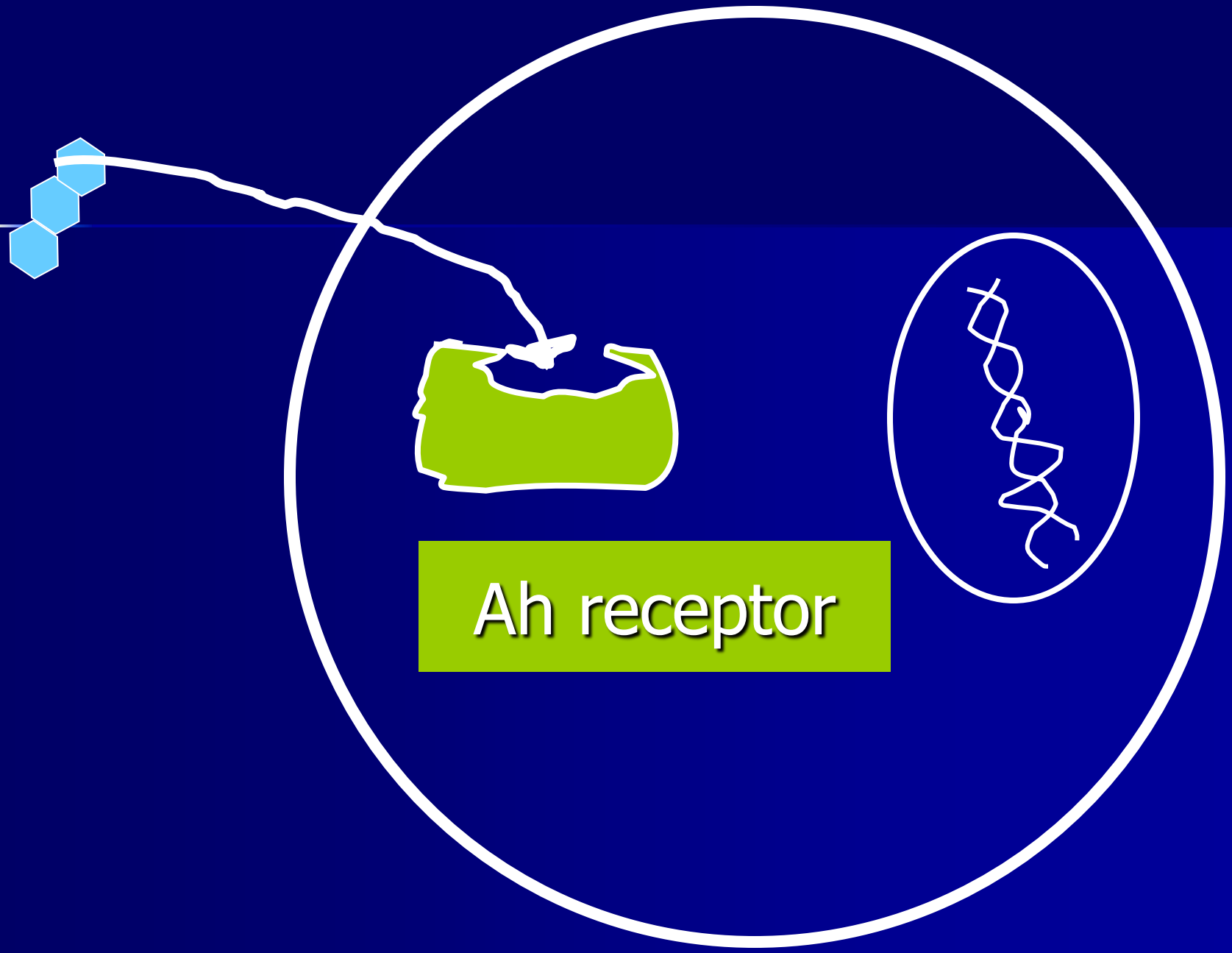
In the ribosome the messenger RNA directs the production of a specific protein



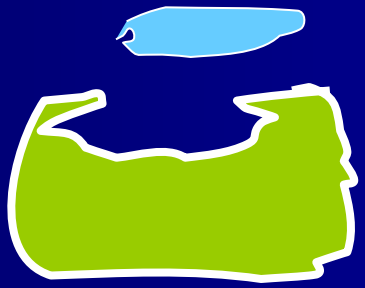

New protein



New protein modifies the activity of the cell

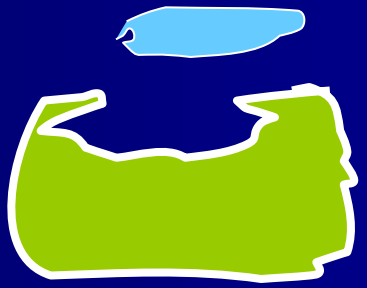

Ah receptor

Two remarkable things about the Ah Receptor



Two remarkable things about the Ah Receptor

1) After 30 years of research scientists do not know what it is in the cell for. They have not identified its normal ligand or function.



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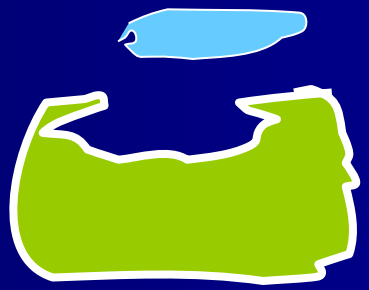

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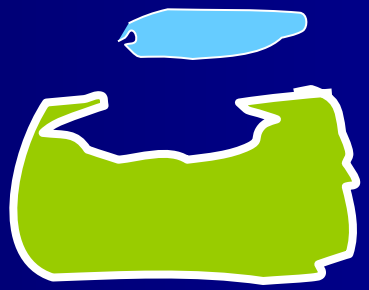

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2) The Ah receptor appears in evolution at the same time as the backbone appears in fish. Every species above invertebrates has the Ah receptor.

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- **Thus the highest dose of dioxin goes to the fetus and then to the new born infant via breastfeeding…**

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- **Linda S. Birnbaum (**Health Effects Research Laboratory, US EPA) Developmental Effects of Dioxins *Environmental Health Perspectives*, 103: 89-94, 1995

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Effect of Dioxins on Neonatal Thyroid Function after Low-exposure and High-exposure at various ages

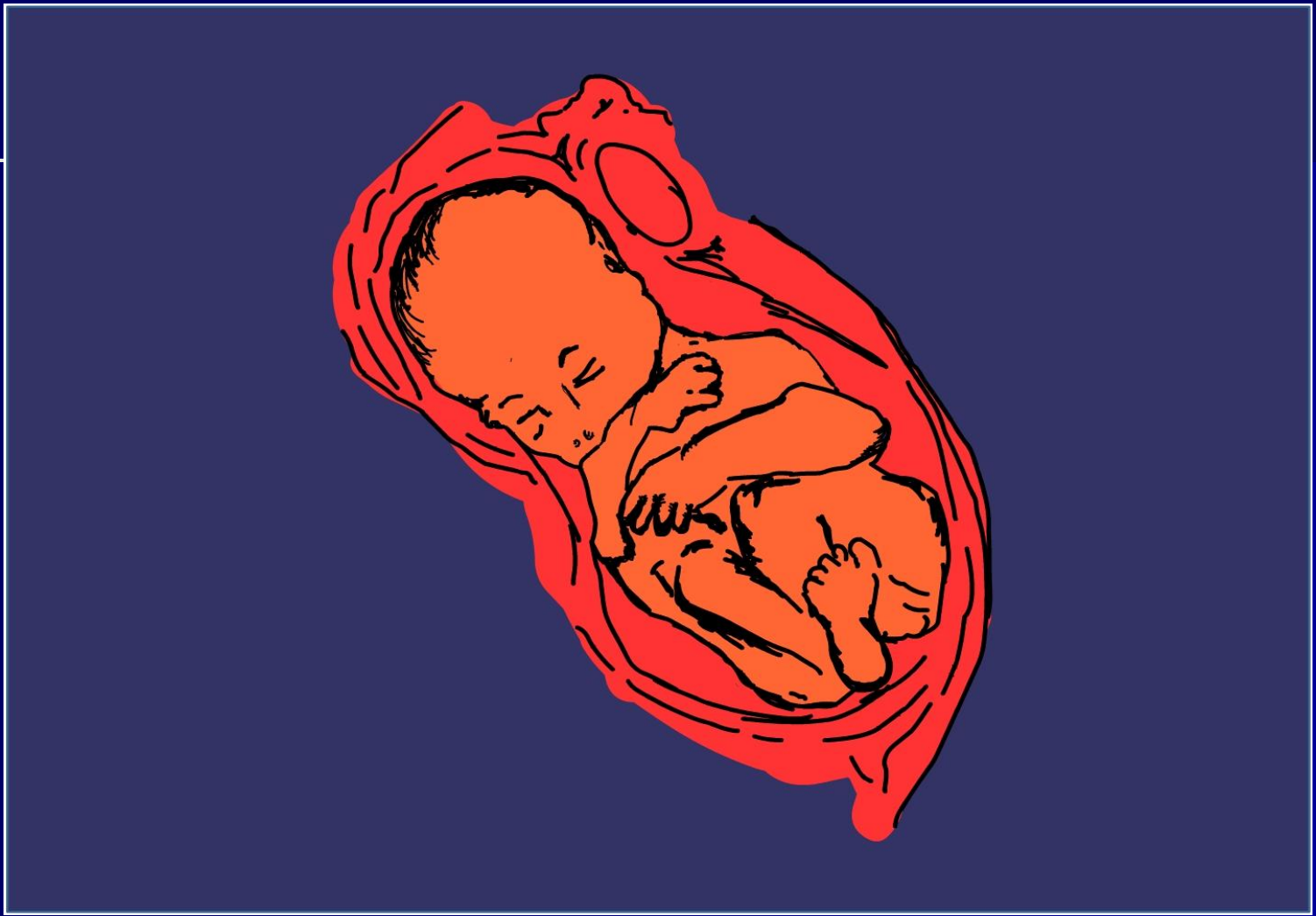
		nLow-exposure n(mean)	nHigh-exposure n(mean)	nP*
nAt birth	nT4	n122.5	n134.3	n0.071
	nT4/TBG	n0.240	n0.232	n0.45
	nTSH	n10.4	n11.9	n0.58
n1 week	nT4	n154.5	n178.7	n0.006*
	nT4/TBG	n0.291	n0.332	n0.006*
	nTSH	n2.93	n2.56	n0.51
n11weeks	nT4	n111.1	n122.2	n0.033*
	nT4/TBG	n0.220	n0.247	n0.040*
	nTSH	n1.81	n2.50	n0.044*

Our Stolen Future

How Man-made Chemicals are Threatening our Fertility, Intelligence and Survival

Theo Colborn
John Peterson Myers
Dianne Dumanoski
1994

WE WANT DIOXIN



OUT OF OUR BABIES!

Institute of Medicine, 2003

Dioxins and Dioxin-like Compounds in the Food Supply

Strategies to Decrease Exposure

July 1, 2003

Institute of Medicine, 2003

Institute of Medicine, 2003

- Fetuses and breastfeeding infants may be at particular risk from exposure to dioxin like compounds (DLCs) due to their potential to cause adverse neurodevelopmental, neurobehavioral, and immune system effects in developing systems…

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- …The committee recommends that the government place a high public health priority on reducing DLC intakes by girls and young women in the years well before pregnancy is likely to occur.

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- (by) Substituting low-fat or skim milk, for whole milk, (and)… foods lower in animal fat…

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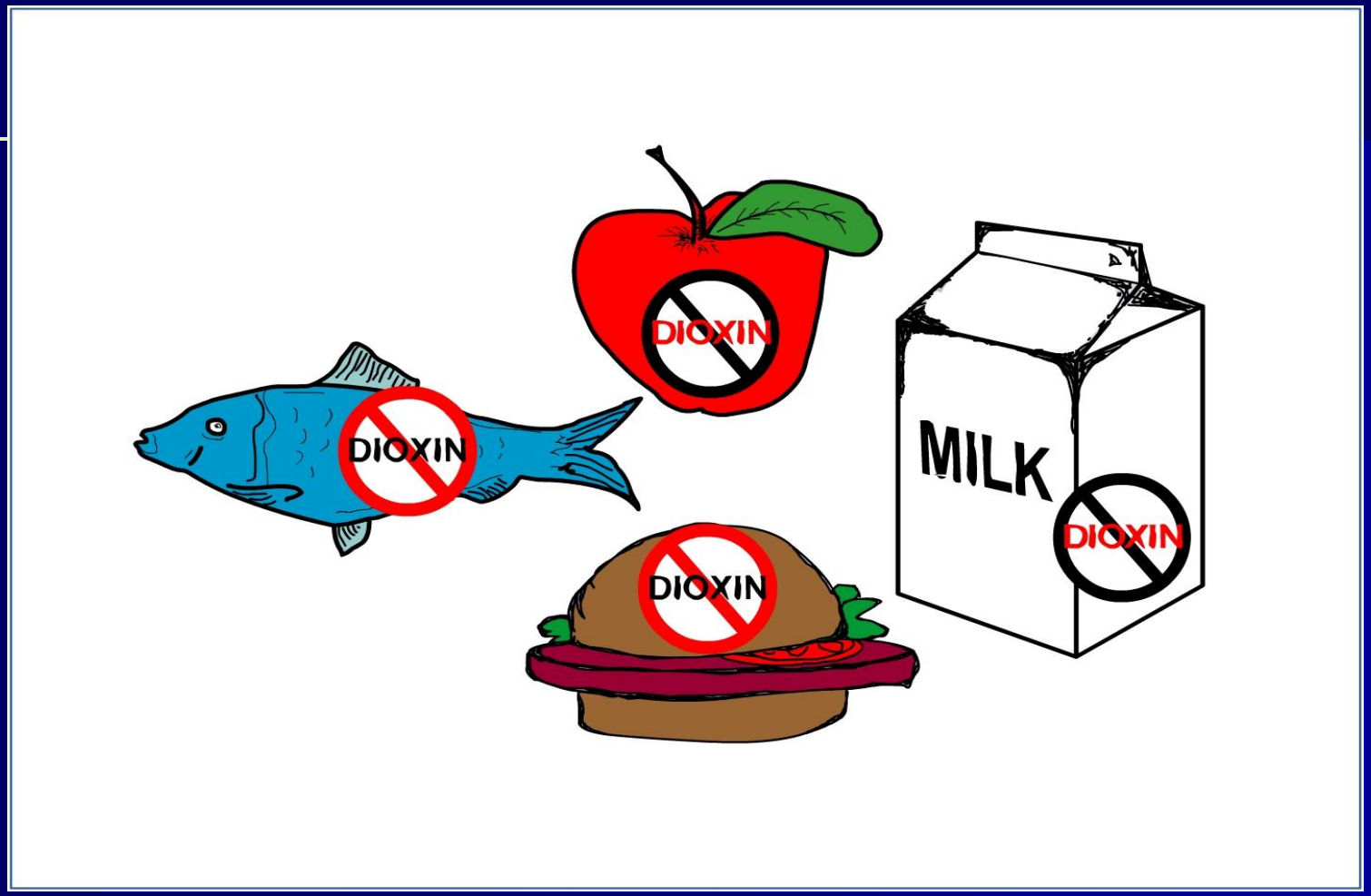

OUT OF OUR FOOD!

Do not build incinerators within 50 km of food production - particularly grazing animals

Promoters say that modern incinerators have solved the dioxin problem, but have they?

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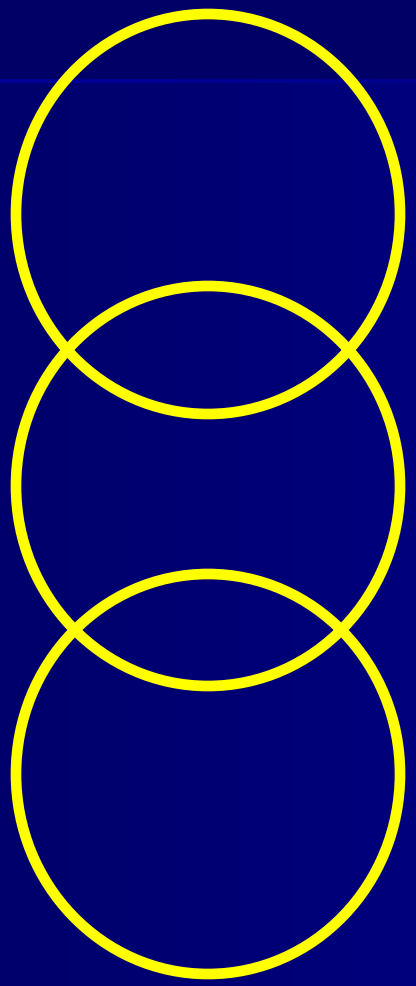
- Wet scrubbing with rapid quenching, as well as a low temperature two-step fine filtration, or both of them together cannot effectively control the volatile metal species and gas-phase PCDD/Fs.
- The removal of PVC from the feed waste stream must also be effective to reduce the emissions of the PCDD/Fs, cadmium and lead species.

While modern incinerators have reduced dioxin emissions
there is no real accountability
in most countries

YOU NEED THREE THINGS TO PROTECT THE PUBLIC FROM TOXIC EMISSIONS.



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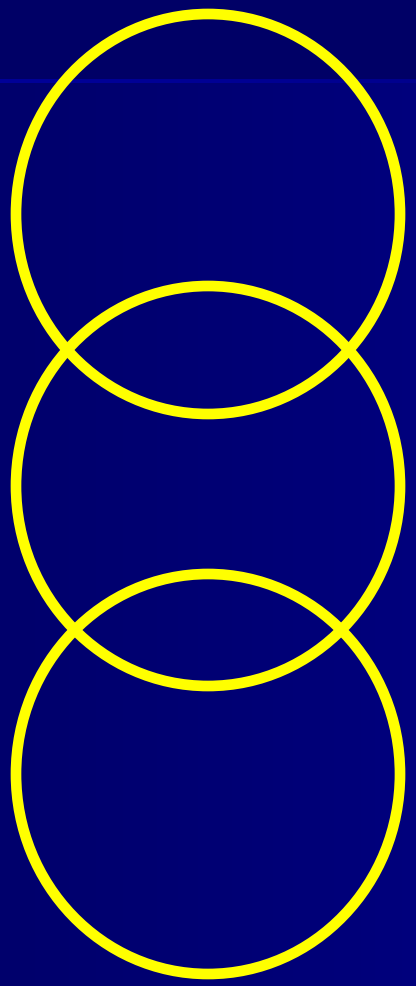

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REGULATIONS

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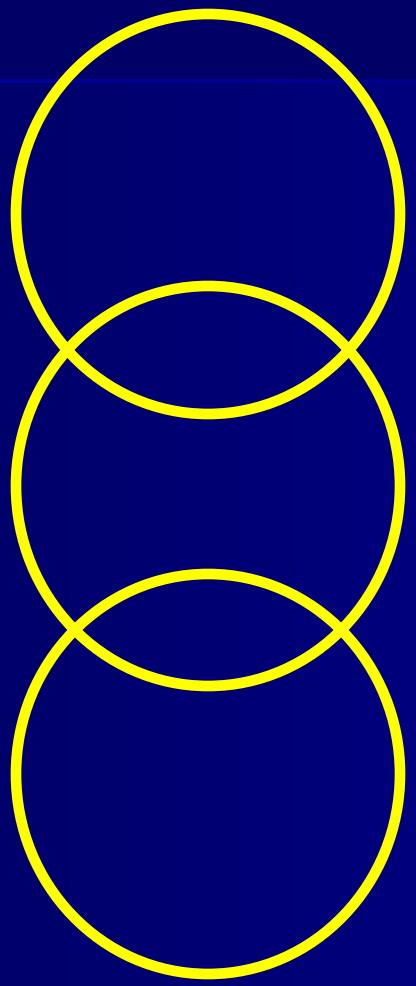

STRONG REGULATIONS

ADEQUATE MONITORING

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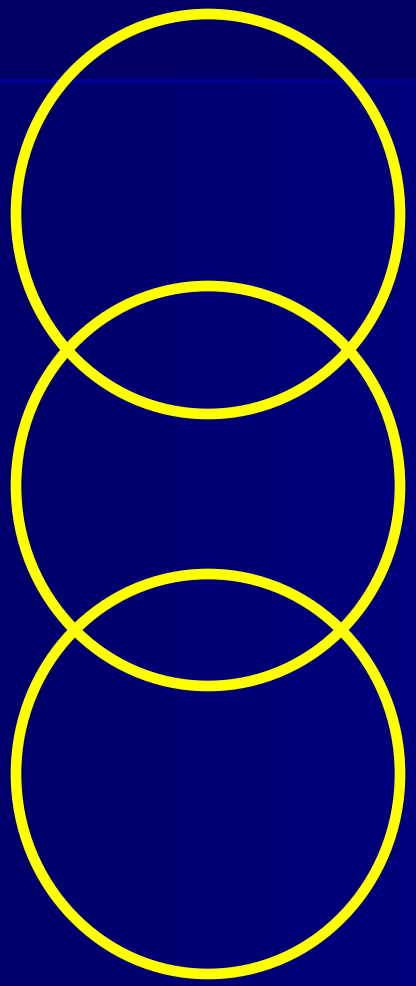

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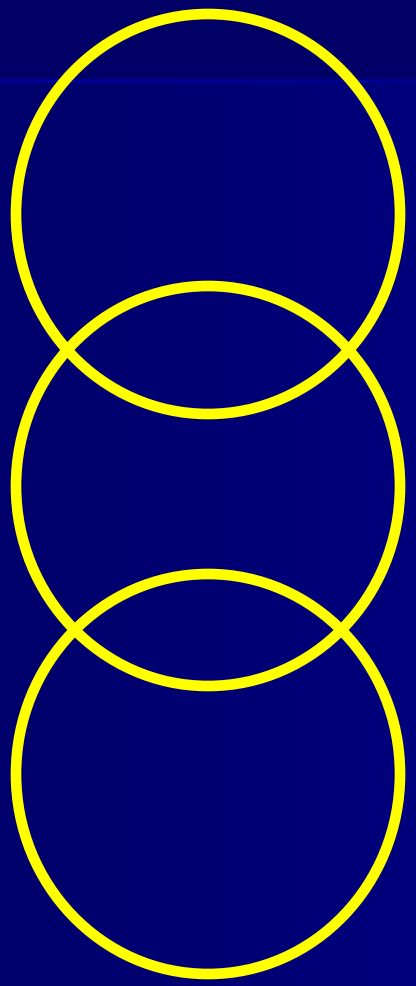

STRONG REGULATIONS

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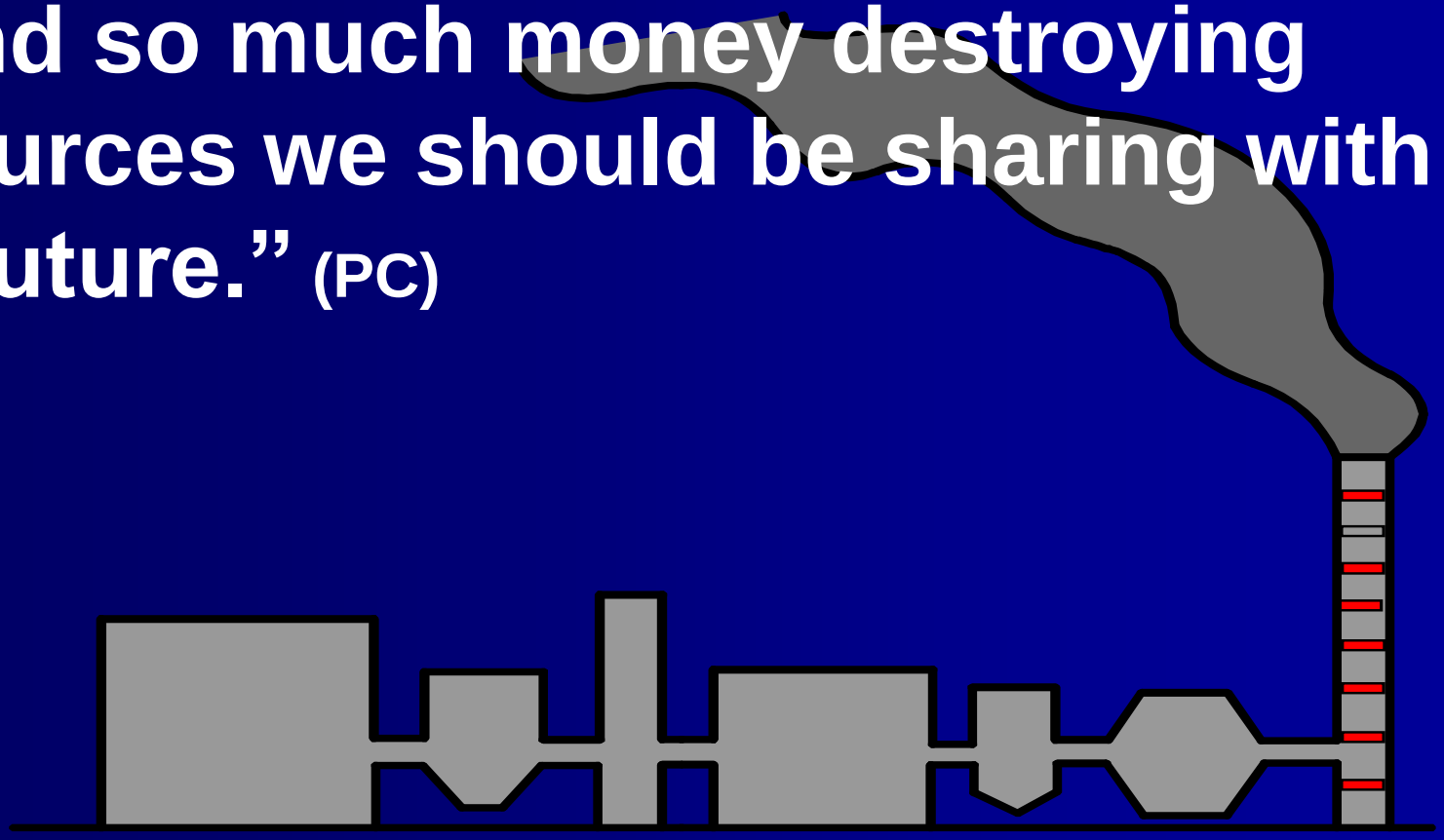
IF ANY LINK IS WEAK THE PUBLIC IS NOT PROTECTED

“Even if we made incineration safe we would never make it sensible.
It simply does not make sense to spend so much money destroying resources we should be sharing with the future.” (PC)



DIFFERENT TIMES DEMAND DIFFERENT QUESTIONS

20th CENTURY

WASTE MANAGEMENT

" How do we get rid of our waste efficiently with minimum damage to our health and the environment ?"

21st CENTURY

RESOURCE MANAGEMENT

" How do we handle our discarded resources in ways which do not deprive future generations of some, if not all, of their value ?"

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SUSTAINABILIY

Incineration is not sustainable

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