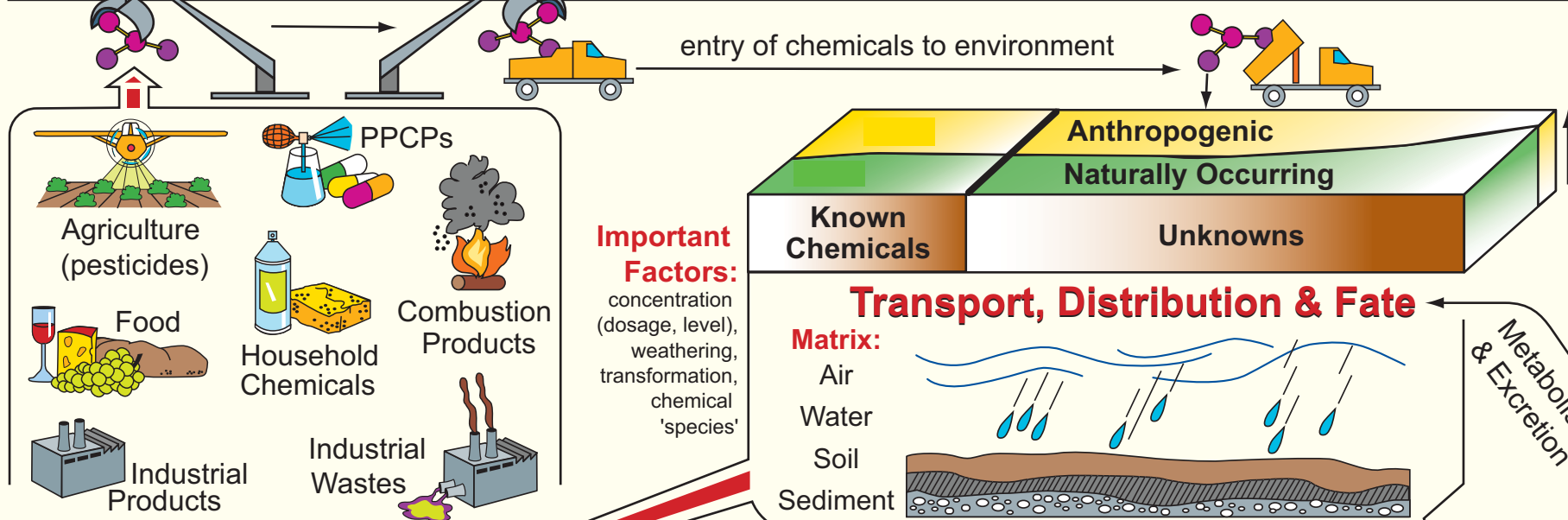


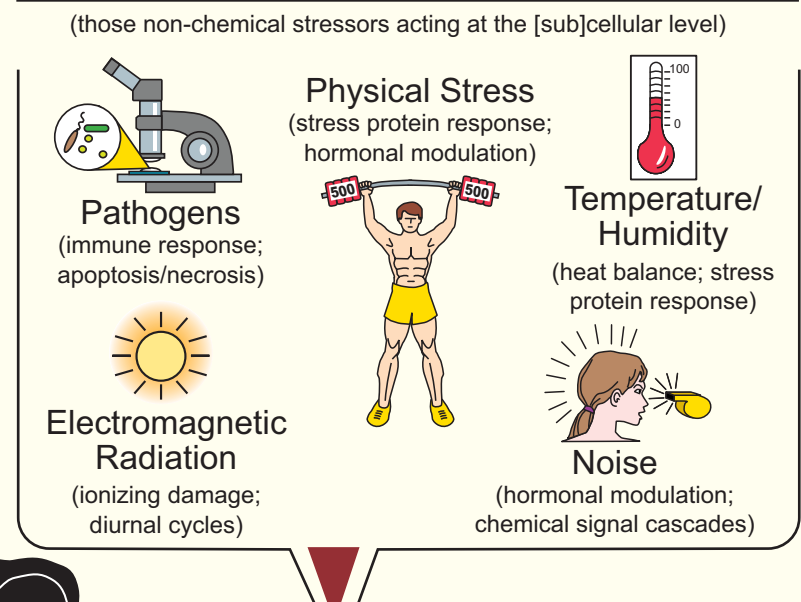


Sources, Origins, Transport
(Characterization of Stressors)

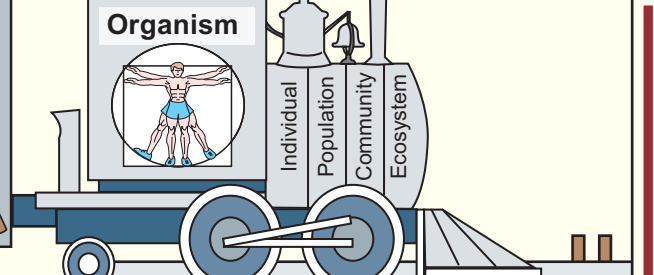
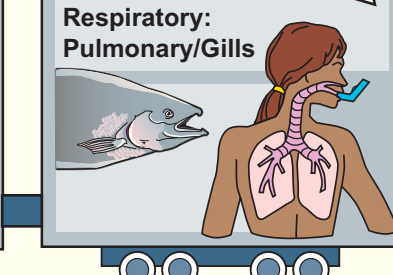
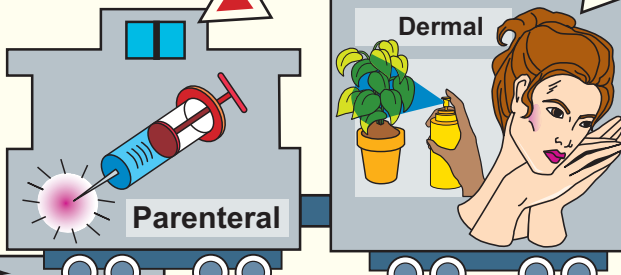
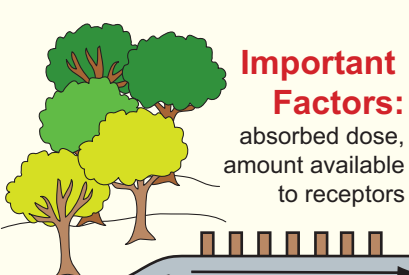
Chemical Universe



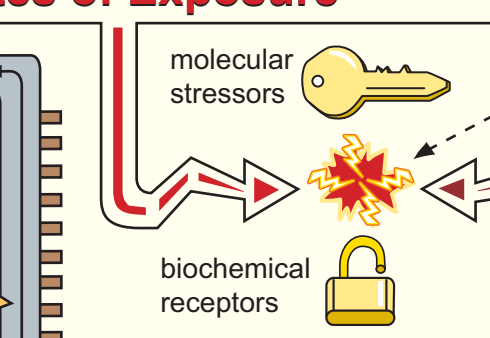
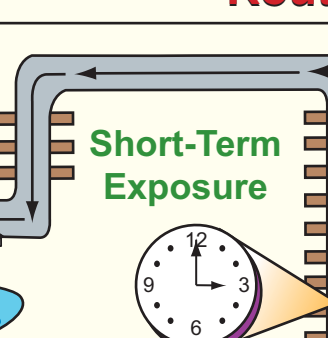
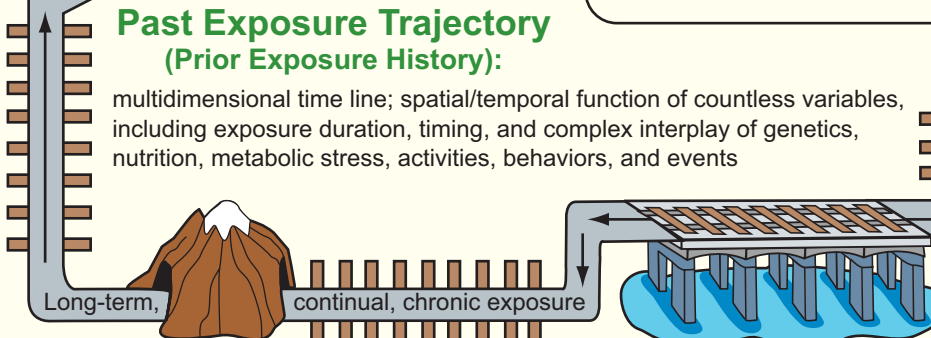
Non-Chemical Universe



Physicochemical
Stressor Universe



Routes of Exposure



"Window of Vulnerability"

Timing: critical time for exposure; developmental/reproductive stage & health status can determine current/future susceptibility to effects

Organism Exposure
Envelope/Trajectory

Interactions/Potentiation

Additive, Synergistic, Antagonistic (can occur from interactions between chemical and non-chemical stressors and a vast, complex array of biological receptors; resulting from similar and dissimilar mechanisms of action)

The 4T's account for an organism's complete exposure time line (a trajectory described by its prior multi-dimensional exposure history) and the fact that a major objective of all organisms is to maintain homeostasis (in the face of continual perturbation by stressors).

- Toxicant:** Toxic chemical (spanning the spectrum of proteinaceous toxins to man-made synthetics; excluding radionuclides).
- Totality:** Emphasizes that organisms can be exposed to a multitude of different members from the large universe of toxicants (not just to individual toxicants in isolation from others).
- Tolerance:** Ability to resist change (susceptibility or vulnerability to perturbing homeostasis; homeostasis can be maintained only within the tolerance bounds for an organism's biochemical defensive repertoire).
- Trajectory:** Individually unique spatial/temporal exposure route experienced by an organism (multidimensional function of its activities and behaviors, as well as isolated/sustained exposure events). Note that any exposure event (short-term, long-term) or exposure phenomenon (e.g., "Window of Vulnerability") may be applicable at any time in an organism's exposure trajectory (past or future).

For more information regarding the many facets of exposure and stressors, see:
<http://www.epa.gov/nerlesd1/chemistry/ppcp/stressors.htm>
<http://www.epa.gov/nerlesd1/chemistry/pharma/critical.htm>

Changes: Overt and Subtle

Effects on health or populations = reactions to exposure
Alteration/disruption to function/processes, morbidity (including mutagenesis, carcinogenesis, teratogenesis), mortality, selective disadvantage, enhancement of function (selective advantage)
No effect = homeostasis (*status quo*)

Effects, Impact,
Consequences,
Significance

This figure is cited from the following web page:

"Biological Systems and Stressors,"

C.G. Daughton, January 2003

<http://www.epa.gov/nerlesd1/chemistry/ppcp/stressors.htm>