

Principles of Environmental Toxicology

EnvS/FST 409/509
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Course

- Introductions.
- Enrollment.
 - Drop/add deadlines.
 - Reading, homework assignments, assessment.
 - Student projects.
 - Exams.
 - Graduate credit.
 - Honor code.
- Web site; Web access via student portal; ETox Live! Blackboard/Skype/Second Life
<http://www.agls.uidaho.edu/etox>

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Environmental Toxicology

- The study of the nature, properties, effects and detection of toxic substances in the environment and in any environmentally exposed species, including humans.

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Motivation

- Why learn about the environment and man's relationship to the environment?

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One View

On earth creatures shall be seen who are constantly killing one another. Their wickedness shall be limitless; their violence shall destroy the world's vast forests; and even after they have been sated, they shall in no wise suspend their desire to spread carnage, tribulations, and banishment among all living beings. Their overreaching pride shall impel them to lift themselves toward heaven. Nothing shall remain on earth, or under the earth, or in the water, that shall not be hunted down and slain, and what is in one country, dragged away into another; and their bodies shall become the tomb and the thoroughfare for all living things they have ruined...

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The fertile earth, following the law of growth, will eventually lose the water hidden in her breast, and this water, passing through the cold and rarified air, will be forced to end in the element of fire. Then the surface of the earth will be burned, and that will be the end of all terrestrial nature.

— Leonardo Da Vinci, 1452-1519



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Role of Science

Science is first of all a set of attitudes. It is a disposition to deal with the facts rather than what someone has said about them...Science is a willingness to accept facts even when they are opposed to wishes... the opposite of wishful thinking is intellectual honesty. Scientists have simply found that being honest - with oneself as well as others - is essential to progress. Experiments do not always come out as one expects, but the facts must stand and the expectations fall. The subject matter, not the scientist knows best. (Skinner, 1953, Science and Human Behavior).

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Course of Study

- Environmental Toxicology.
 - A historical review.
 - Human perspective; molecules of life.
- Concepts of toxicology.
- *Special topic: Pesticide residues.*
- Dose-response.
- Absorption.
- Distribution and storage.

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Course of Study, 2

- Biotransformation and elimination.
- Target organ toxicity.
- Teratogenesis, mutagenesis, carcinogenesis.
- *Special topic: Dioxins and related compounds.*
- Exposure and risk assessment.

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Course of Study, 3

- *Case studies:*
 1. *Selenium Ecotoxicology.*
 2. *Arsenic in Drinking Water.*
- Abiotic transformation.
- Biotic transformation.
- Environmental chemodynamics.
- Environmental transport.
- Environmental chemicals.
 - Case studies.*
- Monitoring environmental chemicals.

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Course of Study, 4

- **Socrates Award: Poison of the Year.**
- Regulating environmental chemicals.
- *Special topic: Endocrine disruption.*
- Future trends in environmental toxicology.



My Expectations

- Mortality and morbidity.
 - Respect for life and the unfortunate people and animals in case study depictions of toxicosis.
- Tolerance.
 - Respect for different points of view and the passions that drive them.
- You will do the hard work of learning.
- Patience with technical failure.

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Perceptions About Chemicals

- What drives our perceptions?
- Are chemicals bad?
- Can you save the planet with pesticides and plastic?

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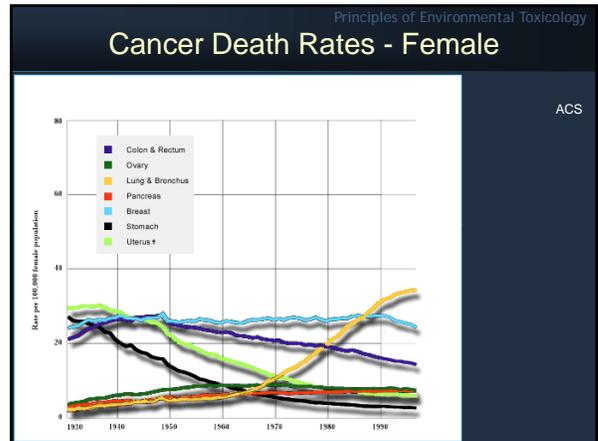
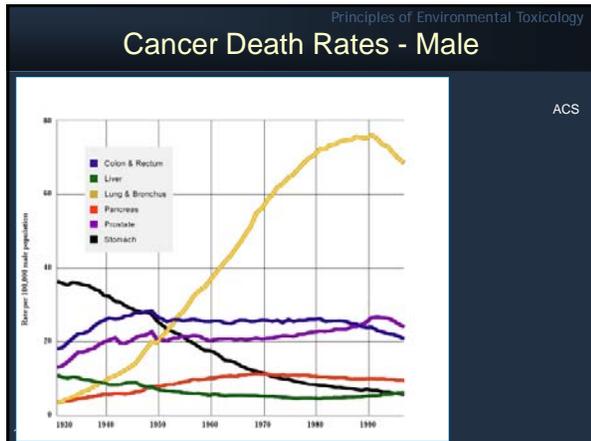
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Perception vs. Reality

- Perception:
 - Pollution is a significant contributor to cancer and that cancer rates are soaring.
- Reality:
 - Life expectancy increasing in industrialized countries.
 - Cancer (non-smoking) death rates steady or going down.

Ames

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Perception vs. Reality, 2

- Perception
 - High dose animal cancer tests tell us the significant cancer risks for humans.
- Reality
 - Half of all chemicals-natural or synthetic-tested in standard animal cancer tests have turned out to be carcinogenic.
 - Near toxic doses-the maximum tolerated dose, can cause chronic cell wounding or mitosis – risk for cancer.

Ames

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Perception vs. Reality, 3

- Perception
 - Human exposures to carcinogens and other toxins are nearly all due to synthetic chemicals.
- Reality
 - Amount of synthetic pesticide residues in plant foods is insignificant compared to the amount of natural plant pesticides.
 - 5-10,000 natural pesticides consumed, totaling 1500 mg/day.

Ames

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Perception vs. Reality, 4

- Perception
 - Synthetic toxins pose greater carcinogenic hazards than natural toxins.
- Reality
 - Proportion of natural chemicals that is carcinogenic when tested in both rats and mice is the same as for synthetic chemicals-roughly half.
 - All chemicals are toxic at some dose.
 - 99.9% of chemicals ingested are natural.

Ames

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Perception vs. Reality, 5

- Perception
 - Toxicology of man-made chemicals is different from that of natural chemicals.
- Reality
 - Humans have many general, natural defenses that make us well buffered against normal exposures to toxins, both natural and synthetic.

Ames

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Perception vs. Reality, 6

- Perception
 - Correlation implies causation.
- Reality
 - No persuasive evidence from either epidemiology or toxicology that pollution is a significant cause of cancer for the general population.

Ames

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Issues Beyond Cancer

- Workplace exposure.
- Endocrine disruption.
- Sub-clinical effects.
- Developmental effects.
- Sensitive populations.
- Multiple exposures.
- Unknown effects.

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Beyond Human Concern

- Unintended endpoints.
 - Off target, off site
- “Confined” organisms.
- Species, genetic effects.
- Biological effects at the organismal and population level.
- Food chain effects.
 - Multi-trophic level.
 - Bioconcentration.



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Who is Responsible?



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