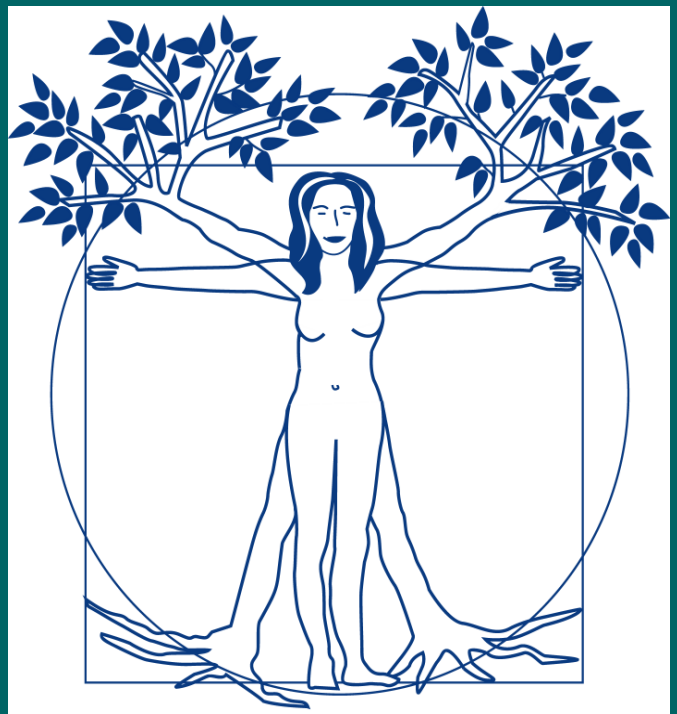

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Emerging technologies and precaution

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Session outline

- Introduction, concerns, and questions
- Jen Sass—nanotechnology
- Doreen Stabinsky--biotechnology
- General discussion

The context for emerging technologies

- “Modern technology has introduced actions of such novel scale, objects, and consequences that the framework of former ethics can no longer contain them”

-Hans Jonas; *The Imperative of Responsibility: In Search of An Ethics for the Technological Age* (1978)

Sources of tension in technological development

- Human creativity, curiosity, and the distribution of risks and benefits
- Cleverness vs. wisdom
- Competing world views, ethics, and values
- Individual rights vs. the public good
- Change vs. the status quo
- Differing views on dealing with uncertainty

Kinds of uncertainty

- Statistical
- Model
- Fundamental
- Manufactured

Statistical uncertainty

- Results from not knowing the value of some variable at a particular point in space or time, but knowing, or being able to determine, the probability of a given value

- Easiest to reduce or quantify

Model uncertainty

- Results from not fully understanding the relationships between variables in a system
- May know that a particular outcome is possible, but probability of that outcome is difficult to predict; may be indeterminate.

Fundamental uncertainty

- Increasing indeterminacy
- Partially results from ignorance
- Ignorance of ignorance a big problem (we don’t know what we don’t know)
- Fail to ask the right questions

Manufactured uncertainty

- Created to serve a particular purpose, often political, economic, or ideological
- Obfuscates
- May depend on lack of “proof”

Science and the precautionary principle

- Kinds of errors and error bias
  - Type 1: false positive
  - Type 2: false negative
  - Type 3: right answer; wrong question
- “Proof”—scientific, social, and political aspects
- “Causation” What do we need to consider in order to say that something “causes” something else?
- The limits of science

Error bias

- Scientific studies are usually interpreted to favor type 2 over type 1 errors
- This is because we have chosen not to conclude that evidence is “significantly positive” without it being “strong”
- ? Should the interpretation of “science” for establishing policies to protect public environmental health favor Type 1 errors?
- Who should decide?

Examples of emerging technologies or emerging concerns with existing technologies

- Biotechnology
- Nanotechnology
- Synthetic biology—completely novel life forms or synthesis of agents with potential for bioterrorism
- Expanded use of wireless communication
- Pharmaceuticals and personal care products in the environment. (PPCPs)
- Novel persistent chemical compounds
- Endocrine disruption—low dose effects; “new” toxicology

Questions to keep in mind

- What are characteristics of emerging technologies that should be explored?
- Are there principles or questions that should apply to all emerging technologies?
- Do we have a DUTY to consider consequences? If so, based on what?
- What have we learned from other technologies?
- What should trigger concerns? Precautionary action?
- Is it possible to say “yes” to new technologies?

Characteristics of concern—examples

- self replication
- mobility
- toxicity
- persistence
- (bio)accumulation
- scale—time, space (geography, widespread use)

Other considerations

- What are “we”/“you” trying to accomplish?
- Does goal setting have a role? Who decides? How do we deal with competing goals?
- Distribution of risks and benefits
- Alternatives

Two points of intervention

- Regulation
  - Often too late. We tend to regulate after discovering that something is a problem. E.g., chemicals, air and water pollutants, traffic control
  - Can regulators realistically intervene before this? E.g, drug safety testing
- Research
  - A public interest research agenda: as a partial substitute for regulation?, to guide funding? what else?

Places to intervene in a system:
Donella Meadows

9. Numbers (subsidies, taxes, regulatory standards).
8. Material stocks and flows.
7. Regulating negative feedback loops.
6. Driving positive feedback loops.
5. Information flows.
4. The rules of the system (incentives, punishment, constraints).
3. The power of self-organization. (change, evolution)
2. The goals of the system.
1. The mindset or paradigm out of which the goals, rules, feedback structure arise.

Does precaution always mean saying “no”?

- Saying “yes” to new technologies
  - Monitoring (monitoring can sometimes identify new problems with old technologies—e.g. PPCPs)
  - Performance bonds
  - Pilot at a scale “safe to fail”
  - Favor technologies that emerge from a research agenda based on the public good/interest
  - Other?

“Unrecognized risks are still risks; uncertain risks are still risks; and denied risks are still risks.”

-- John Cairns, Jr.

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