

Frontiers for Worker Education and Training

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New Challenges Panel

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Gandhi's Deadly Sins



Wealth without Work
Pleasure without Conscience
Science without Humanity
Knowledge without Character
Politics without Principle
Commerce without Morality
Worship without Sacrifice

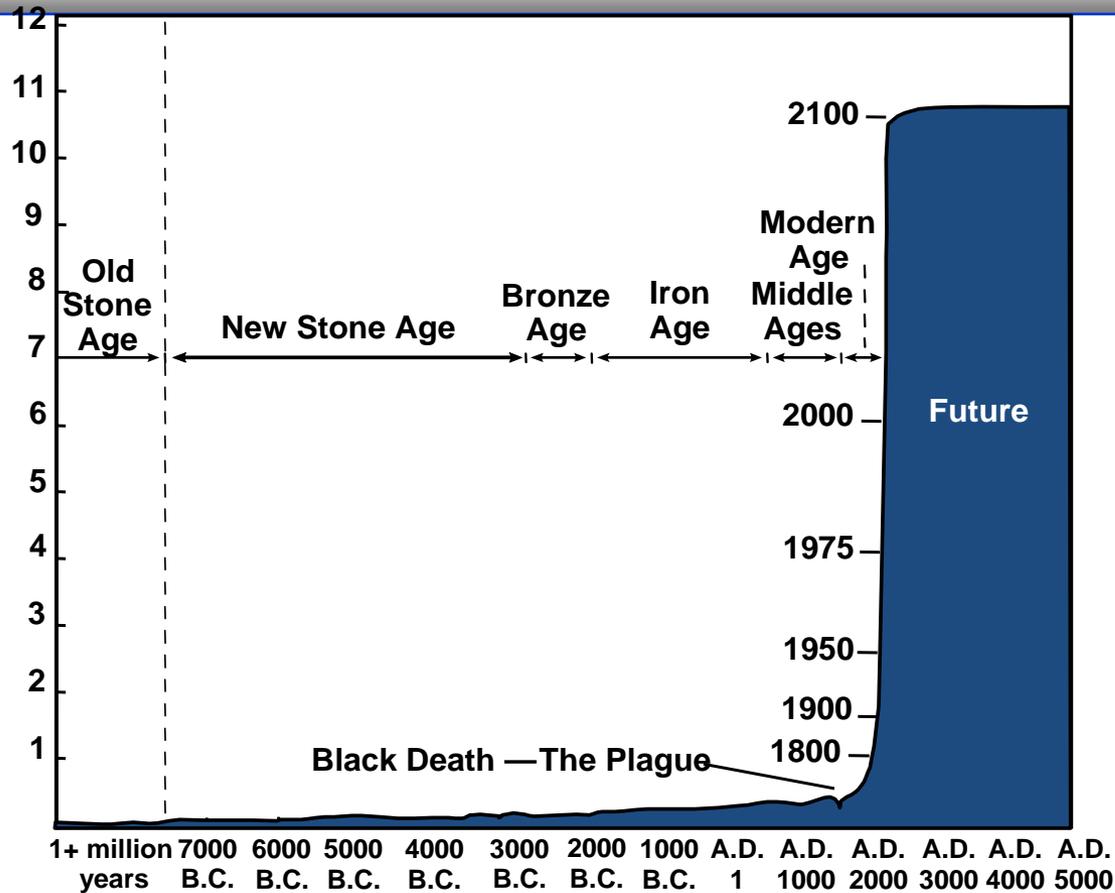
Monumental Challenges

- Human population growth
- Human consumption
- Climate Change
- Species loss



World Population Growth Through History

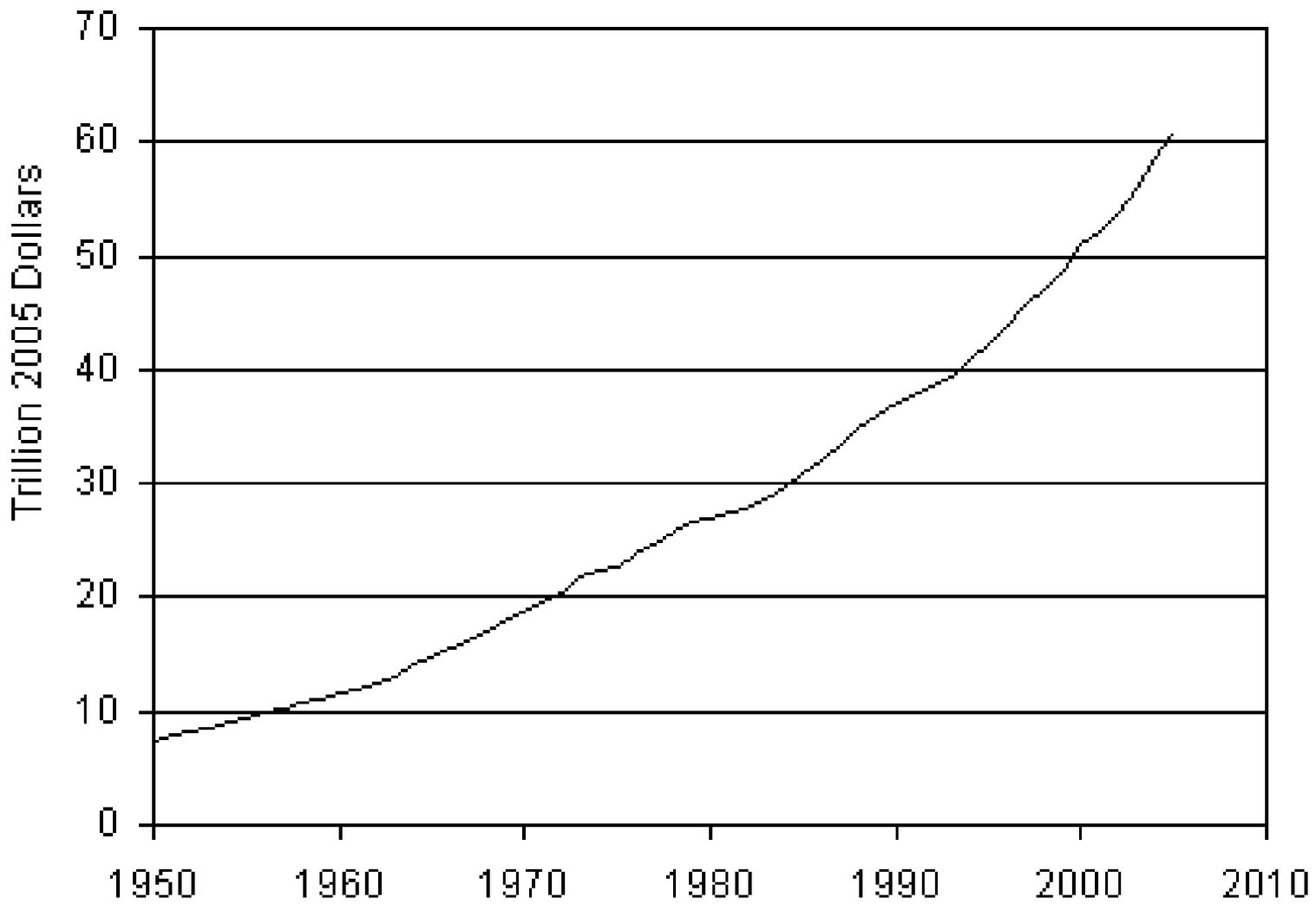
Billions



Source: Population Reference Bureau; and United Nations, *World Population Projections to 2100* (1998).



Gross World Product, 1950-2005



Source: IMF, Worldwatch



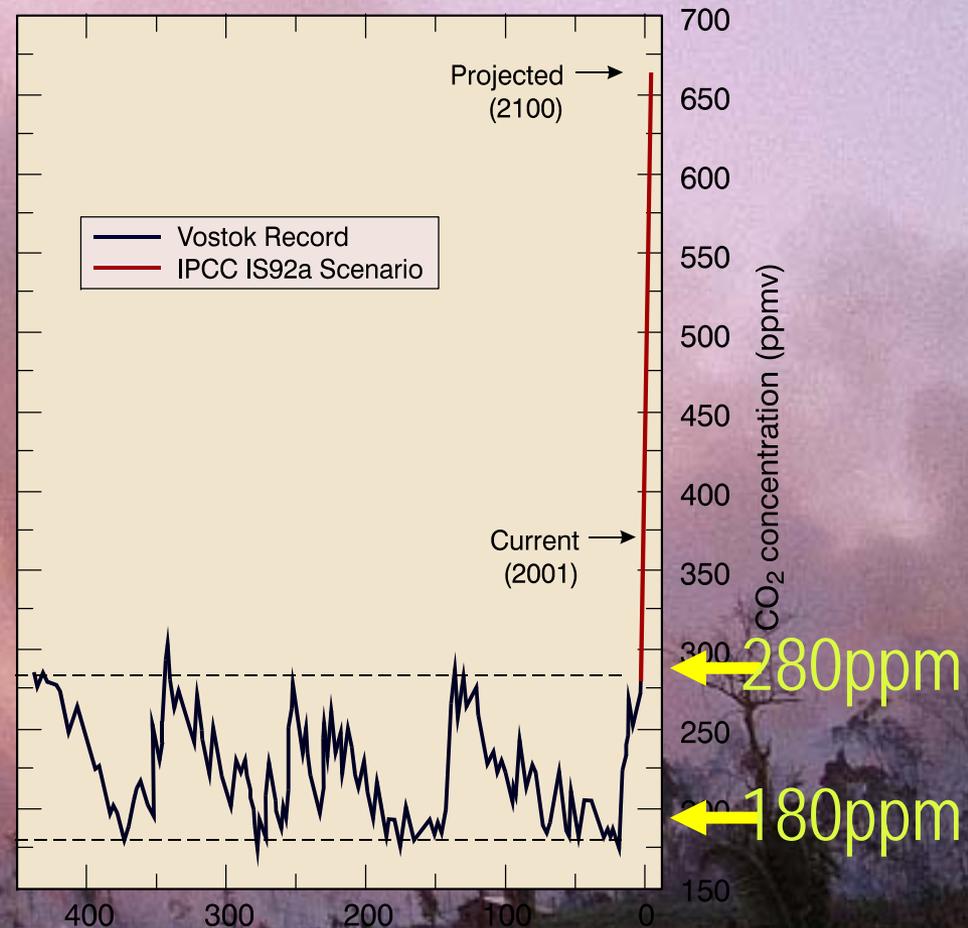
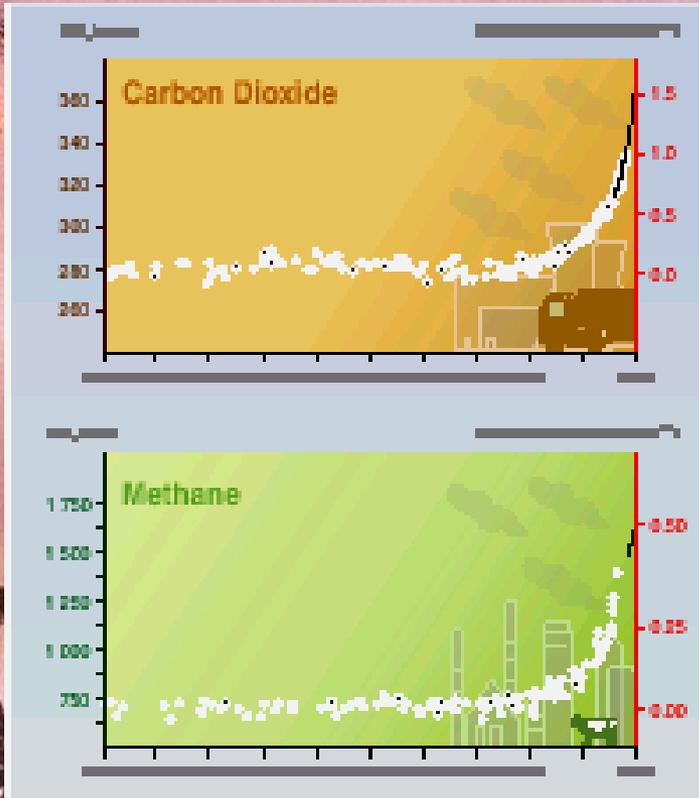
Vital Statistics

World Fossil Fuel Consumption

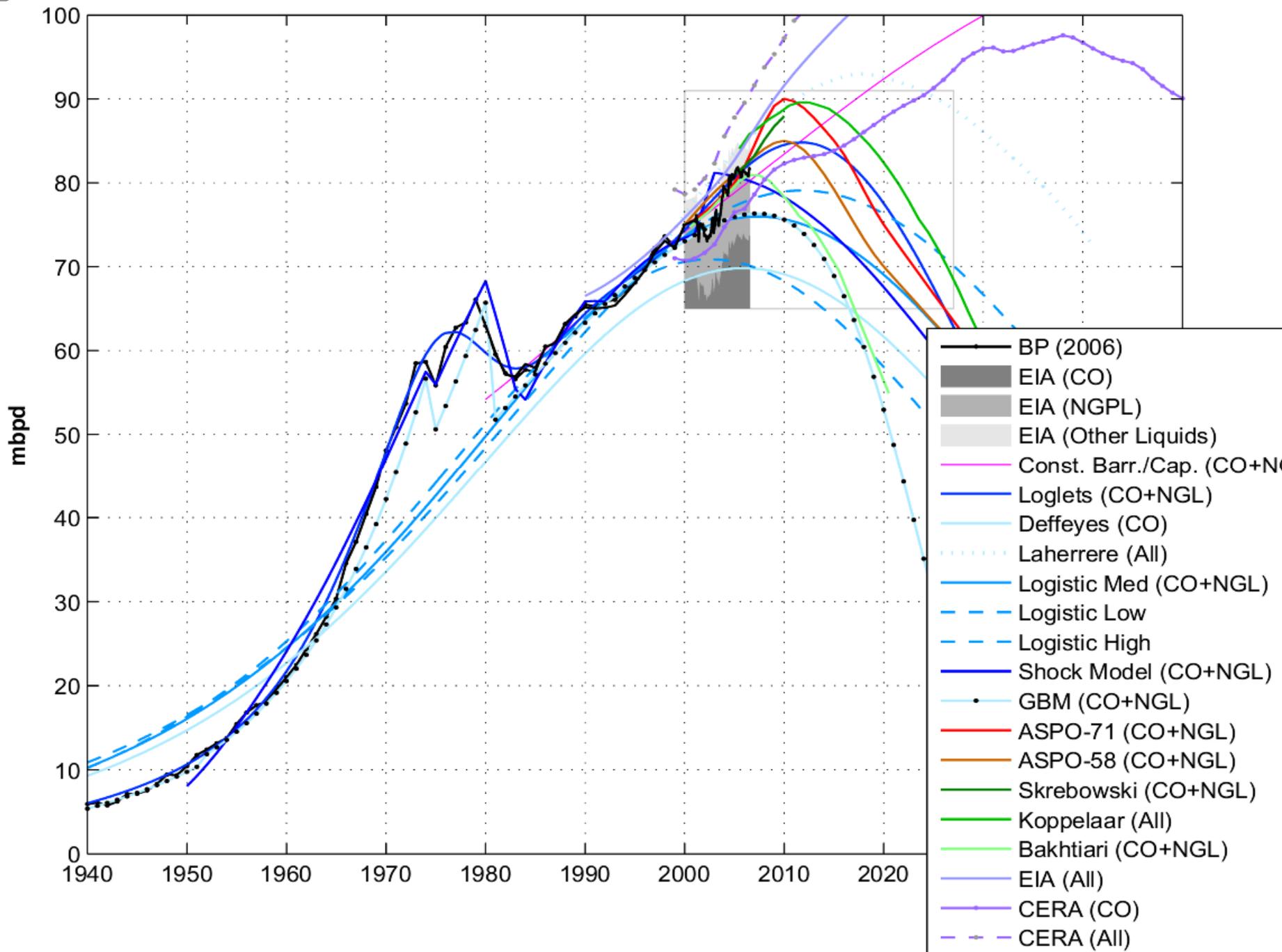
(Million tons oil equivalent)

	1950	2002	Increase
Coal	1074	2298	2x
Oil	470	3529	7x
Natural Gas	171	2207	10x

Past and future atmospheric composition



World Production



20,000+ Species Doomed

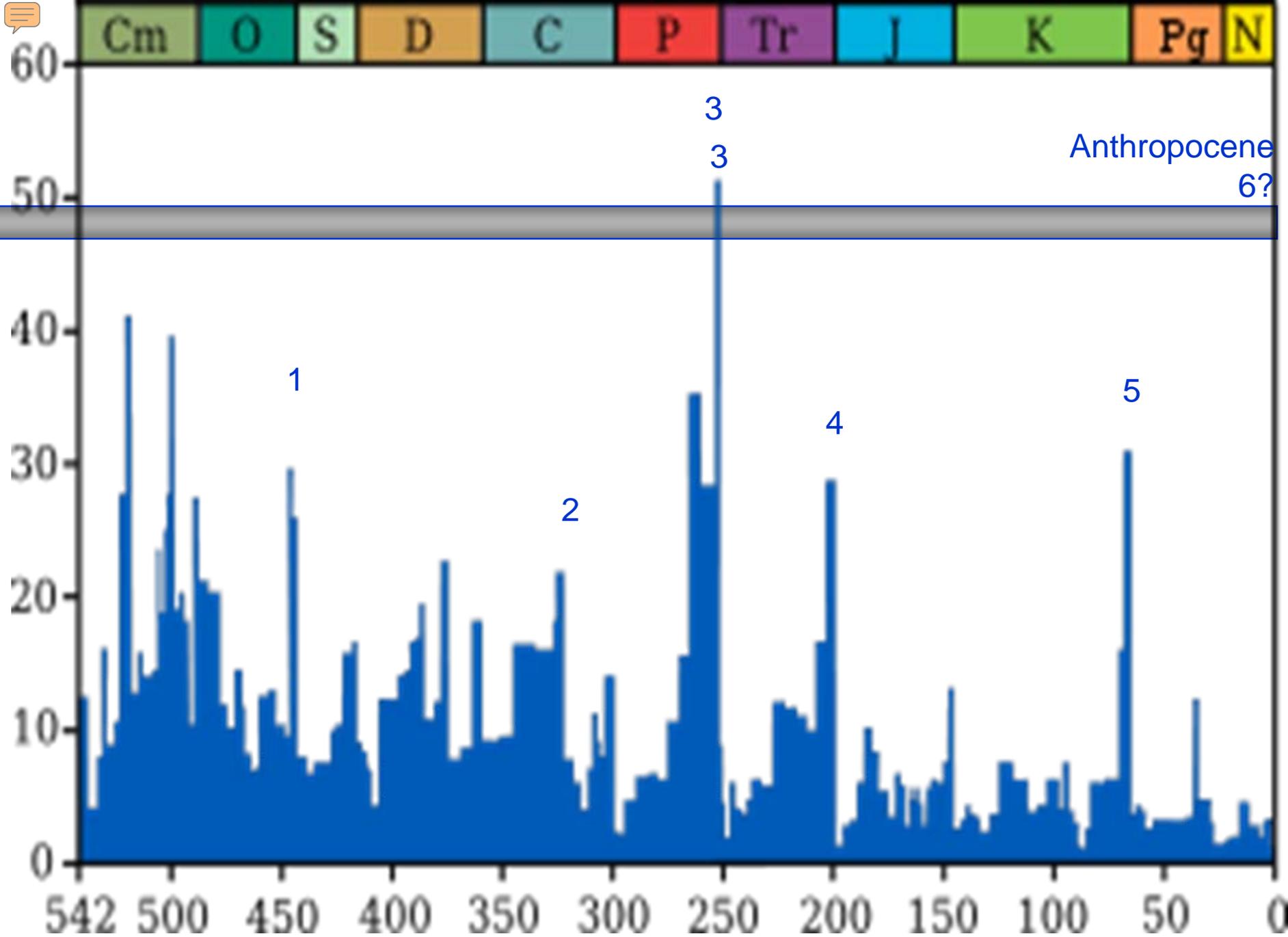
1% annual tropical rain forests
destruction

Estimated total of 10 million species

100 year projection

= 20,000 to 30,000 species.

Edward O. Wilson



Chemicals Horizon

- REACH impact
- Gene-Environment Advances
- New American Policy



Chemicals and Occupational diseases/fatalities in Europe

- 18 % of workers handle hazardous substances and 20,5 % inhale toxics (EU-25, Dublin Foundation, 2006)
- 26 000+ worker deaths due to hazardous chemical exposures during 2001 (EU-15, ILO, 2005)
- One out of every three occupational diseases annually related to chemical exposures (EU-15, Eurostatdata, 2004)

Burden of Proof shifts onto industry

**Pre-registration - 143,000 substances by
65,000 companies (2008)**

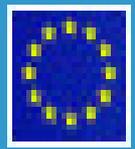
**Registration: manufactured or imported
Substance Information Exchange Fora**

New Test Data

Substances of Very High Concern (2009)

Restrictions and Safer Alternatives

International Data Exchange



REACH Guidance

Registration, Evaluation, Authorisation and restriction of Chemicals

REACH Chemical Assessment

Hazard assessment

PBT and vPvB assessment

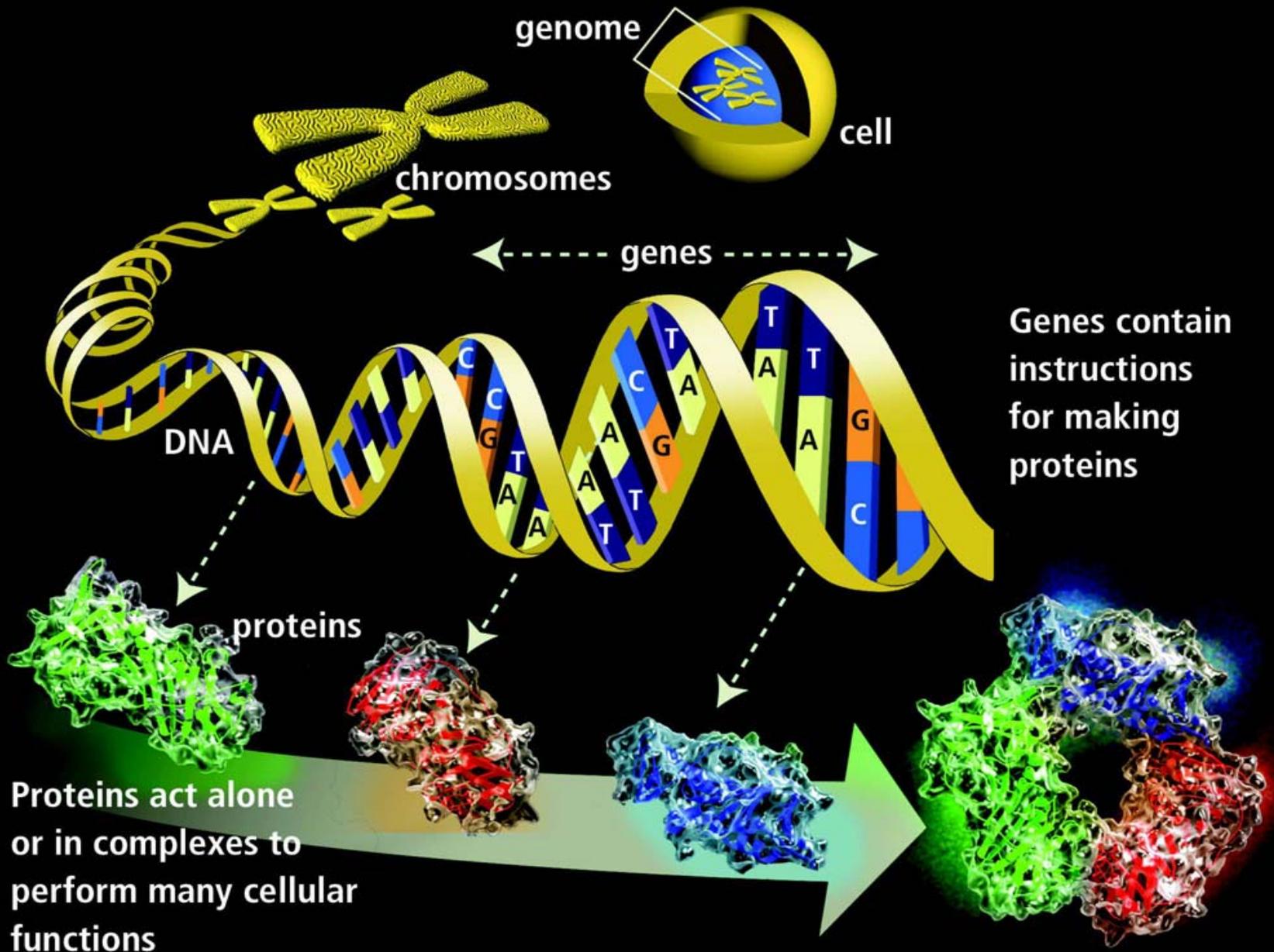
Exposure assessment

Risk Characterization

Chemical Report

Extension of Safety Data Sheet

New Toxicology Approaches



New Toxicological Science

Genomics

Proteomics

Metabolomics

Instrument development

Information science

Machine Intelligence

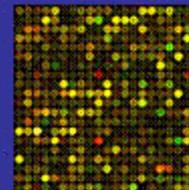
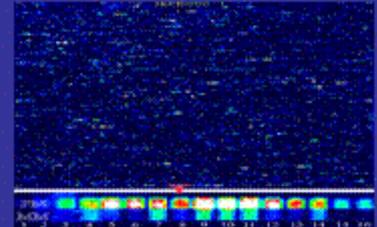
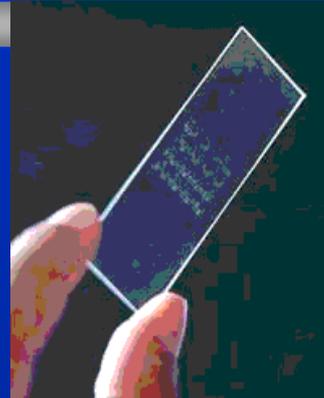
Current Approach

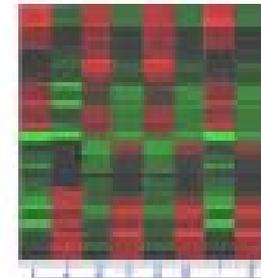
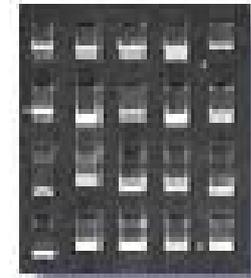
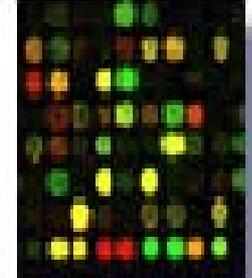
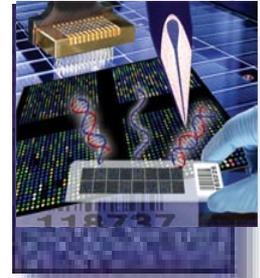
- Many animals
- Low throughput
- Expensive
- Time consuming
- Pathology endpoints
- Dose response extrapolations over a wide range
- Application of uncertainty factors rather than predictive tools of human health outcomes
- Little focus on mode of action and biology
- Few epidemiology studies



Future Approach

- In vitro assays
- Less expensive
- More rapid results
- Biomolecular endpoints
- At exposure levels of interest, limited dose response extrapolations
- More predictive of human health outcomes
- Lesser use of uncertainty factors
- Primary focus on modes of action and microbiology
- Many molecular epidemiology studies



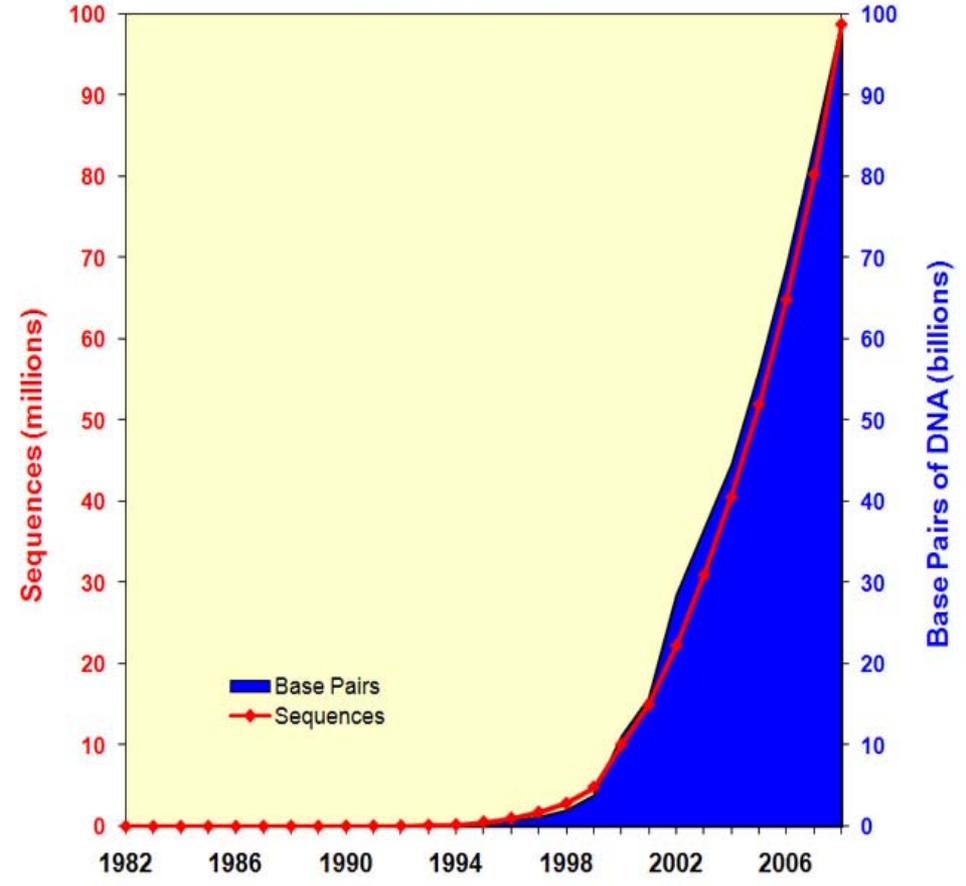


**Moore's Law
comes to Life**

**Essential
Stakeholder roles**



**Growth of GenBank
(1982 - 2008)**





NAS Studies Inform New Policy and Approaches

- Phthalates and Cumulative Risk
- Toxicity Testing in 21st Century
- Advancing Risk Assessment
- Human Biomonitoring

Legislative Initiatives

National Stimulus

Obama Triple Priorities:

Health care

Education

Energy

Other Issues:

Chemical Security

TSCA Reform - KSCA

Safer States - MA example



Five Minds for the Future

Discipline Mind

Synthesizing Mind

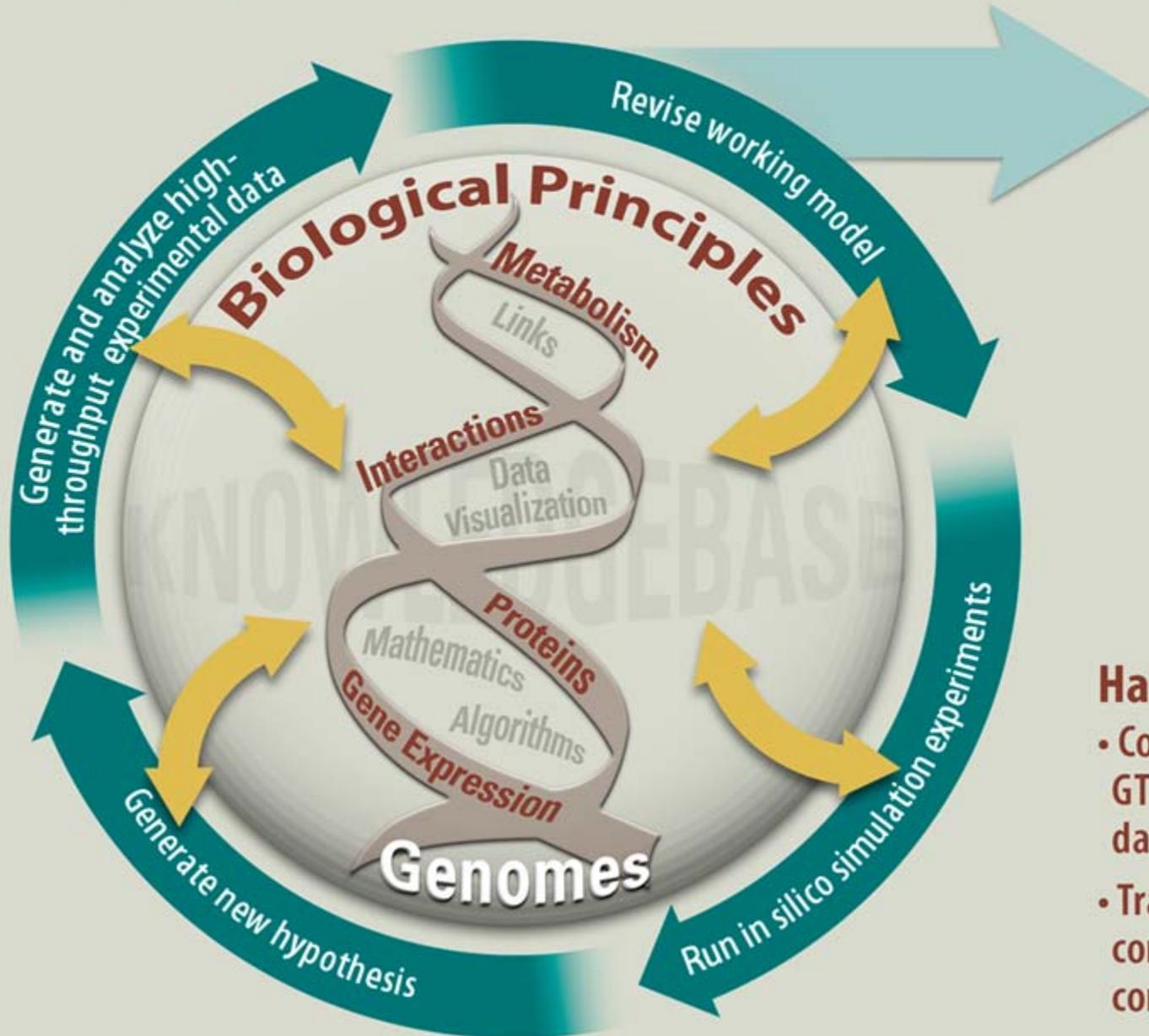
Creative Mind

Respectful Mind

Ethical mind

Building the GTL Systems Biology Knowledgebase

Revealing biological principles will lead to an increasingly accurate understanding of function



Genome-based predictive understanding of systems function

Hallmarks

- Comprehensive integration of GTL and research community databases
- Transparent and intuitive community access to computational tools