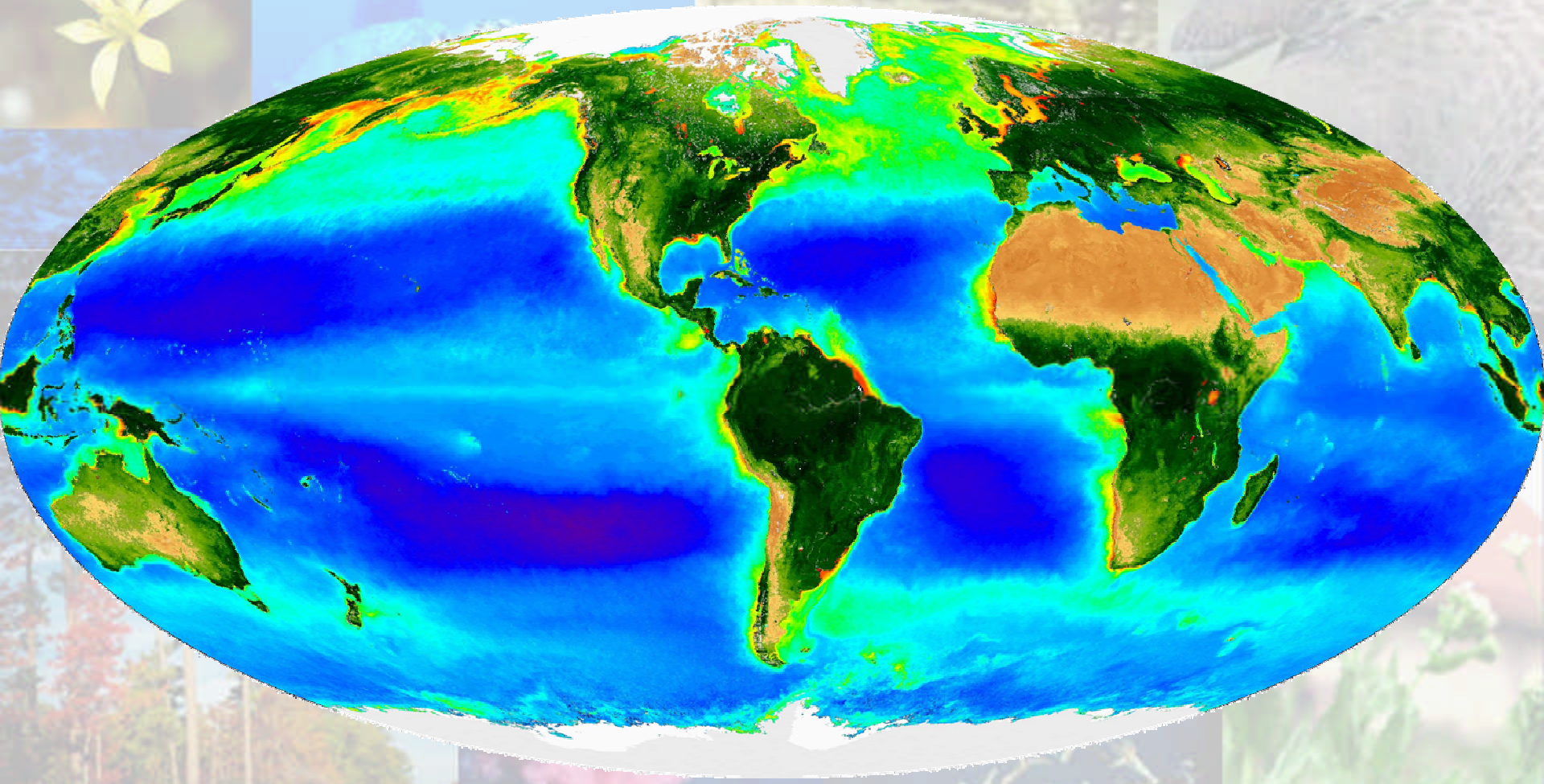
Bio-Collections: Preserving the Past to Serve the Future

Kathie L. Olsen, PhD
Associate Director for Science
Office of Science and Technology Policy

May 26, 2004

The Global Biosphere

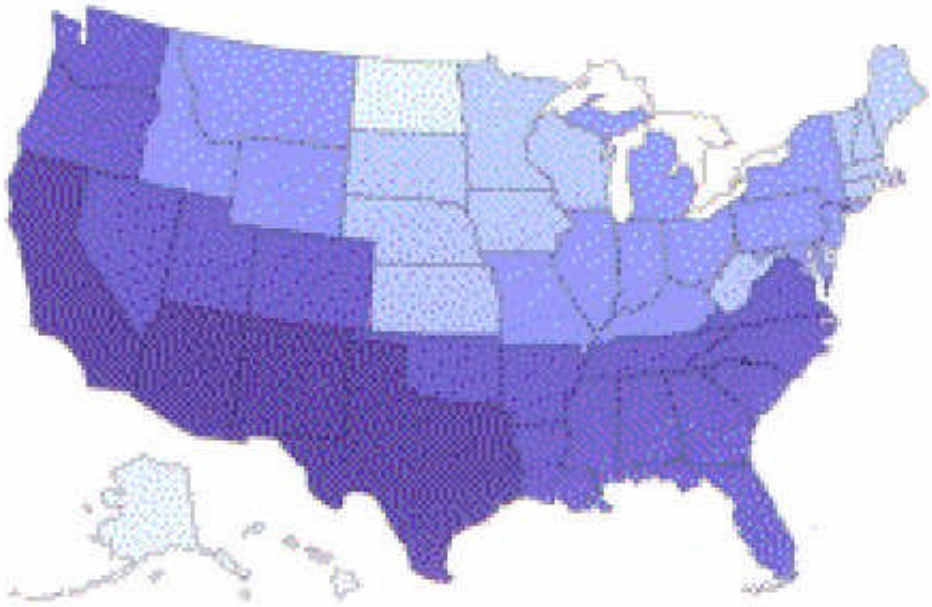


Understanding the WHOLE of it!

How Big is the Job?

- About 10,000 new species discovered each year
  - 1-5 birds, 1-5 mammals
- About 60,000-70,000 species have been studied
- Genomics databank (GenBank) has information on about 100,000 species
- Catalog of Life 2004 – lists 323,000 species
  - Species 2000 (international) in partnership with ITIS (partnership of federal agencies)
- Around 1.75 million species have been discovered and described
- Anywhere from 2-100 million may exist
  - (Michael Rosenzweig, Society for Conservation Biology)
- Extinction rates: 10-100 / day
  - Difficult to estimate

US Biodiversity

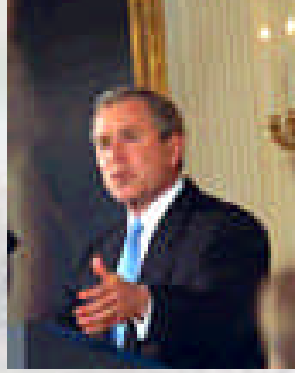


Source: The Nature Conservancy and Association for Biodiversity Information

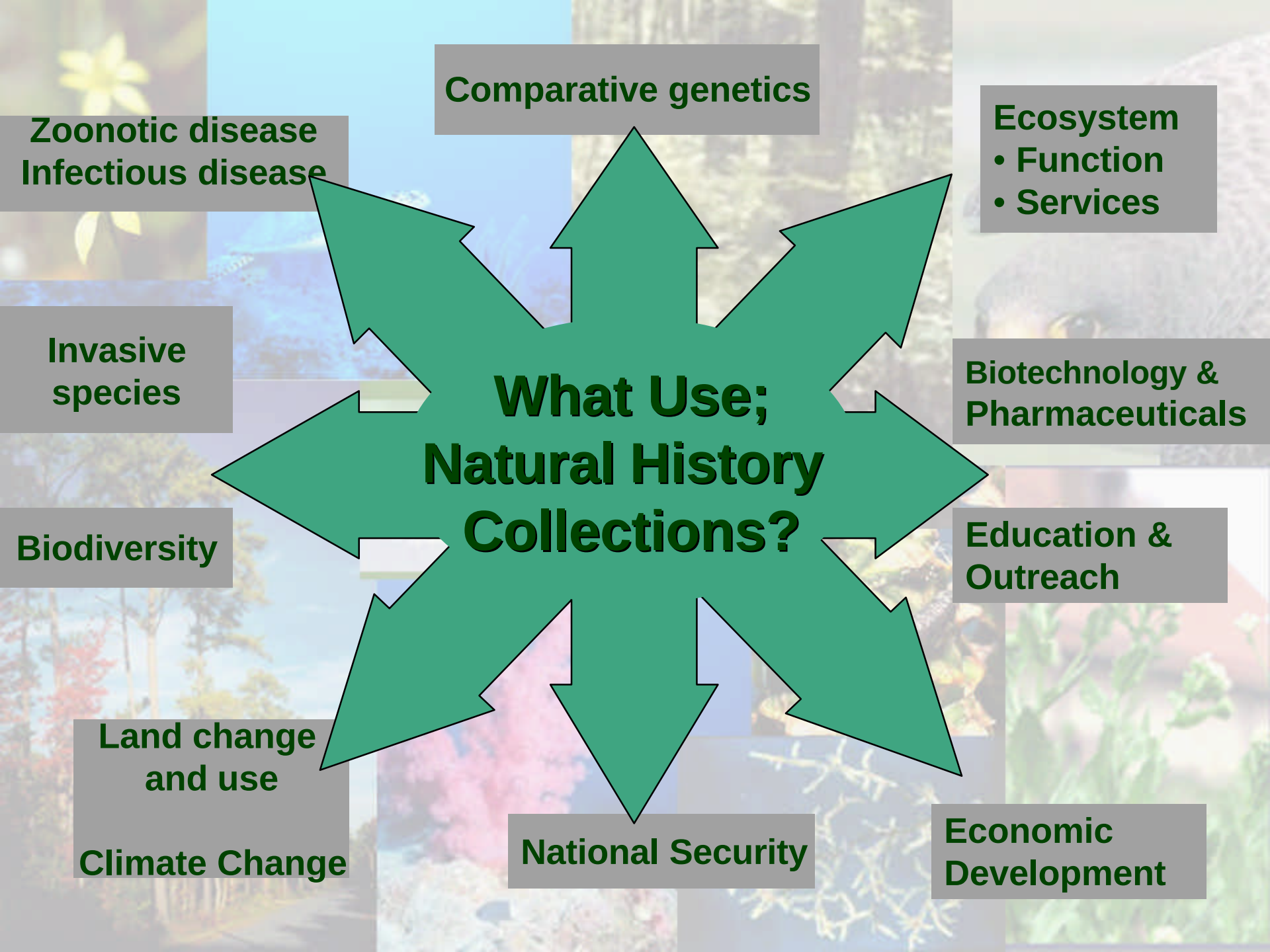
The Role of the Federal Government in Science & Technology

- Improve Nation's ability to:
  - Innovate
  - Enable Discoveries
  - Sponsor development of critical and enabling technologies
  - Maximize return on investments through cooperation across Federal agencies
- Ensure National Security
- Strengthen the Economy
- Improve Health & Well-being
- Ensure an Educated Society

Role of White House Office of Science & Technology Policy



- Advise the President & Offices of the President
- Lead the interagency effort to develop S&T policies and budgets for ALL AREAS OF SCIENCE
  - Co-chair National Science & Technology Council (NSTC)
  - Co-chair President's Council of Advisors on Science and Technology (PCAST)
- Build strong partnerships among federal, state and local governments, Other countries, industry, Academia & Scientific Associations
- Develop clear, measurable goals and objectives for R&D programs
- Access Federal investments relative to purposes of government


Comparative genetics
Ecosystem
• Function
• Services
Zoonotic disease
Infectious disease
Invasive species
What Use; Natural History Collections?
Biotechnology & Pharmaceuticals
Biodiversity
Education & Outreach
Land change and use
Climate Change
National Security
Economic Development

US Collections

- More than 500 million specimens of plants and animals
- 200 years of biological exploration in the U.S.
- Numerous, diverse collections
  - Museums, universities, government facilities, private collectors
- Unique natural history—irreplaceable record of national heritage
- Facing numerous challenges
  - Deteriorating facilities—potential for loss
  - Need to network together using modern information technologies
  - Unidentified or misidentified specimens
  - Few taxonomists

Public-Private Partnerships are ESSENTIAL

Federal Government

- Collections
- Scientists
- Funding
- Infrastructure
- International collaboration

Natural History Museums, Universities, Botanical gardens, Societies, etc.

- Collections
- Scientists
- Funding
- Infrastructure
- International collaboration

Neither the government nor the private sector "owns" this subject, but the preservation and utilization of these collections is of great national importance


What are we doing in DC?

Federal Agency Systematics and Biodiversity Funding Programs*

- National Science Foundation
  - Biological Research Collections Program
  - Biological Databases and Informatics Program
- US Department of Agriculture
  - Agriculture Research Service and Beltsville Agricultural Research Center
- Smithsonian museum of Natural History
- US Geological Survey—NBII
- USAID
  - Bio-net International
- NOAA
  - NOAA Fisheries National Systematics Laboratory

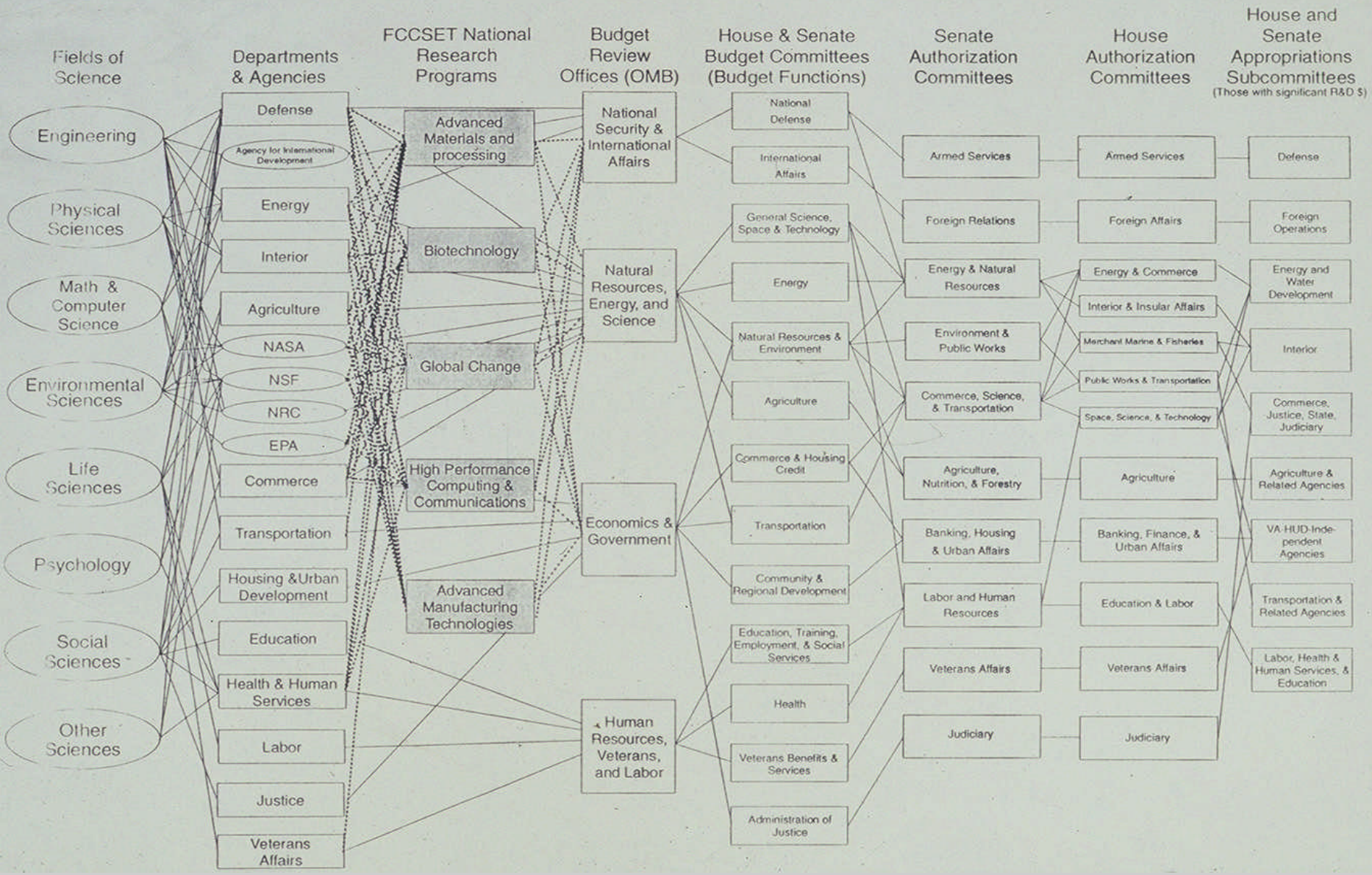
* Not necessarily exhaustive

How do we set America's S&T Priorities?

Development of the Federal R&D Budget

Showing Fields of Science and Executive and Legislative Decision Units

Connecting lines indicate loation of agency budget decisions, but not decision sequences.



Establishing Program Priorities

Science Priority Criteria

Science Return

Benefit to Society

Mandated Program

Appropriate for Feds

Partnership Opportunity

Technology Readiness

Program Balance

Cost/Budget Context

Implementation Priority Criteria

Natural Science Collections Alliance

- International community of institutions that house natural science collections and use them in
  - Research
  - Exhibitions
  - Academic and informal science education
  - Outreach
- The only organization that represents systematic and other natural science collections
- > 80 member institutions
- > 30 scientific societies
- Several hundred individuals

The Program Decision Process

Top down
(Agency management, OMB, Congress)

- Priorities
- Budget
- Strategic Planning
- DECISIONS

- Ideas
- Concepts
- Planning
- Capability development

Bottom's up
(academia, industry, Agency S&E personnel)

Current NSTC Structure

National Science and Technology Council
Director, OSTP

Committee on Environment & Natural Resources

WH: Olsen
DOC: Lautenbacher
EPA: Gilman

- Global Change Research
- Air Quality Research
- Disaster Reduction
- Ecosystems
- Toxics & Risks
- Water Availability & Quality
- IWG Earth Observations

Committee on Science

WH: Olsen
NSF: Colwell
NIH: Zerhouni

- Research Business Models
- Education & Workforce Dev.
- Large Scale Science
- Aquaculture
- Human Subjects Research
- IWG Physics of the Universe
- IWG Plant Genome
- IWG Dom. Animal Genomics
- R&D Investment Criteria
  Research Misconduct Policy

Committee on Technology

WH: Russell
DOC: Bond

- Technology Dev.
- Networking Information & Technology
- Nanoscale Science, Eng. & Technology
- Aerospace

Committee on Homeland and National Security

WH: Dale
DOD: Wynne
DHS: McQueary

- National Security R&D
- Radiological/Nuclear Countermeasures
- International
- WMD Medical Countermeasures
- Standards

- Infrastructure
- Biotechnology
- IWG on Dioxin
- Oceans
- Social, Behavioral & Econ.
- Health and the Environment.

Legend
Informal
Under development

National Biological Information Infrastructure

- Broad-based, collaborative program amongst federal, state, international, non-government, academic, and private industry partners
- Funded by the USGS with additional Federal agency partners:
  - Other Interior agencies
  - EPA
  - NOAA
  - NASA
  - NSF
  - Smithsonian
  - USDA
  - DOE

Interagency Taxonomic Information System

- Partnership of federal agencies formed to satisfy their mutual needs for scientifically credible taxonomic information
- Original Partners
  - Department of Commerce
    - National Oceanic and Atmospheric Administration (NOAA)
  - Department of Interior (DOI)
    - Geological Survey (USGS)
  - Environmental Protection Agency (EPA)
  - Department of Agriculture (USDA)
    - Agriculture Research Service (ARS)
    - Natural Resources Conservation Service (NRCS)
  - Smithsonian Institution
    - National Museum of Natural History (NMNH)

Training, Education, and Capacity Development

- **NSTC Committee on Science- Subcommittee on Research Business Models:**
  - **New Ways of doing Research**
    Funding Mechanisms
    Rewards Systems
    Training Opportunities

- **NSTC Committee on Science- Subcommittee on Education & Workforce:**

Student exploring 3D visual environment


Bio-
Collections
Are
Global

Species 2000

- Global network based in the UK and Japan
- Federation" of database organizations working closely with users, taxonomists and sponsoring agencies
- Objective of enumerating all known species of organisms on Earth (animals, plants, fungi and microbes) as the baseline dataset for studies of global biodiversity
- Initially organized through the United Nations Environment Programme (UNEP) and the Global Environment Facility (GEF)

Global Biodiversity Information Facility (GBIF)

- International non-profit organization to provide free and universal access to data regarding the world's biodiversity
- 25 voting country participants
- 16 associate participants—countries/economies
- 26 associate participants—organizations (including ITIS & Species 2000)

Informatics for Bio-Collections

What's needed?

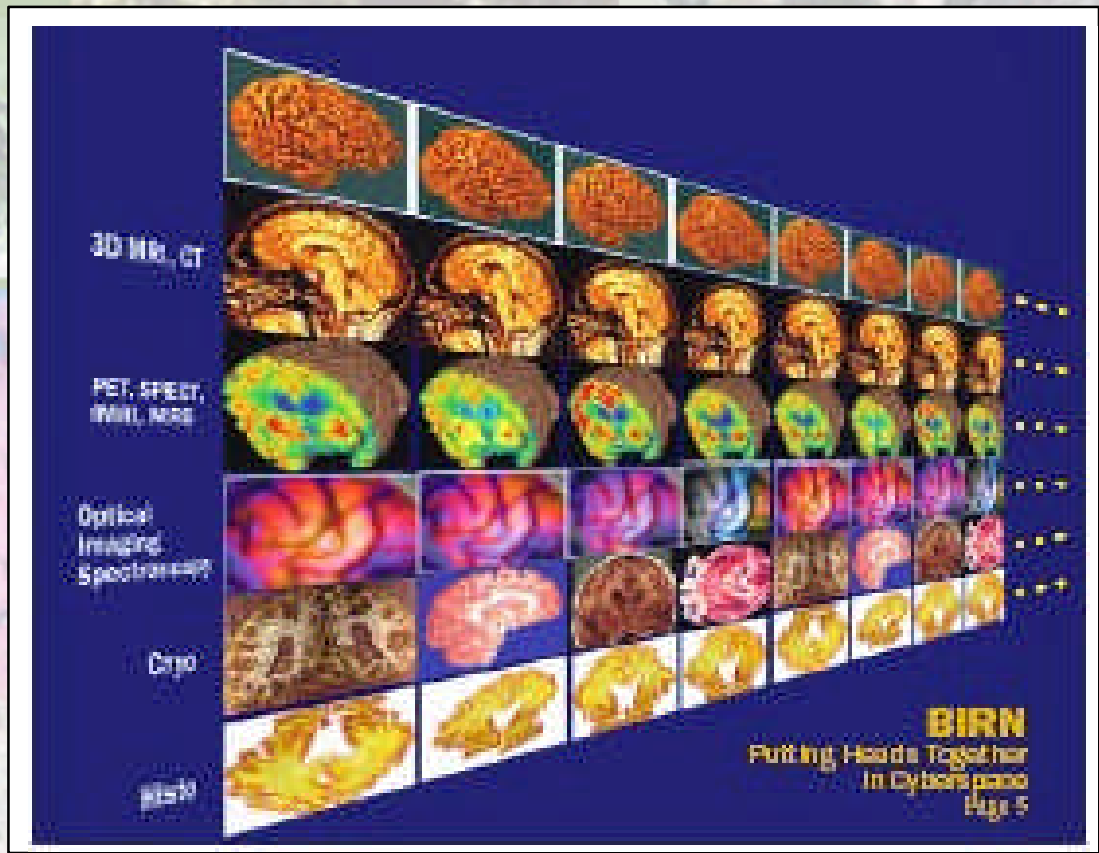
- Science/User requirements
- Technology
- Partnerships
- Infrastructure
- Training, Education, Capacity development
- Policy
- Accountability

Science/User Requirements

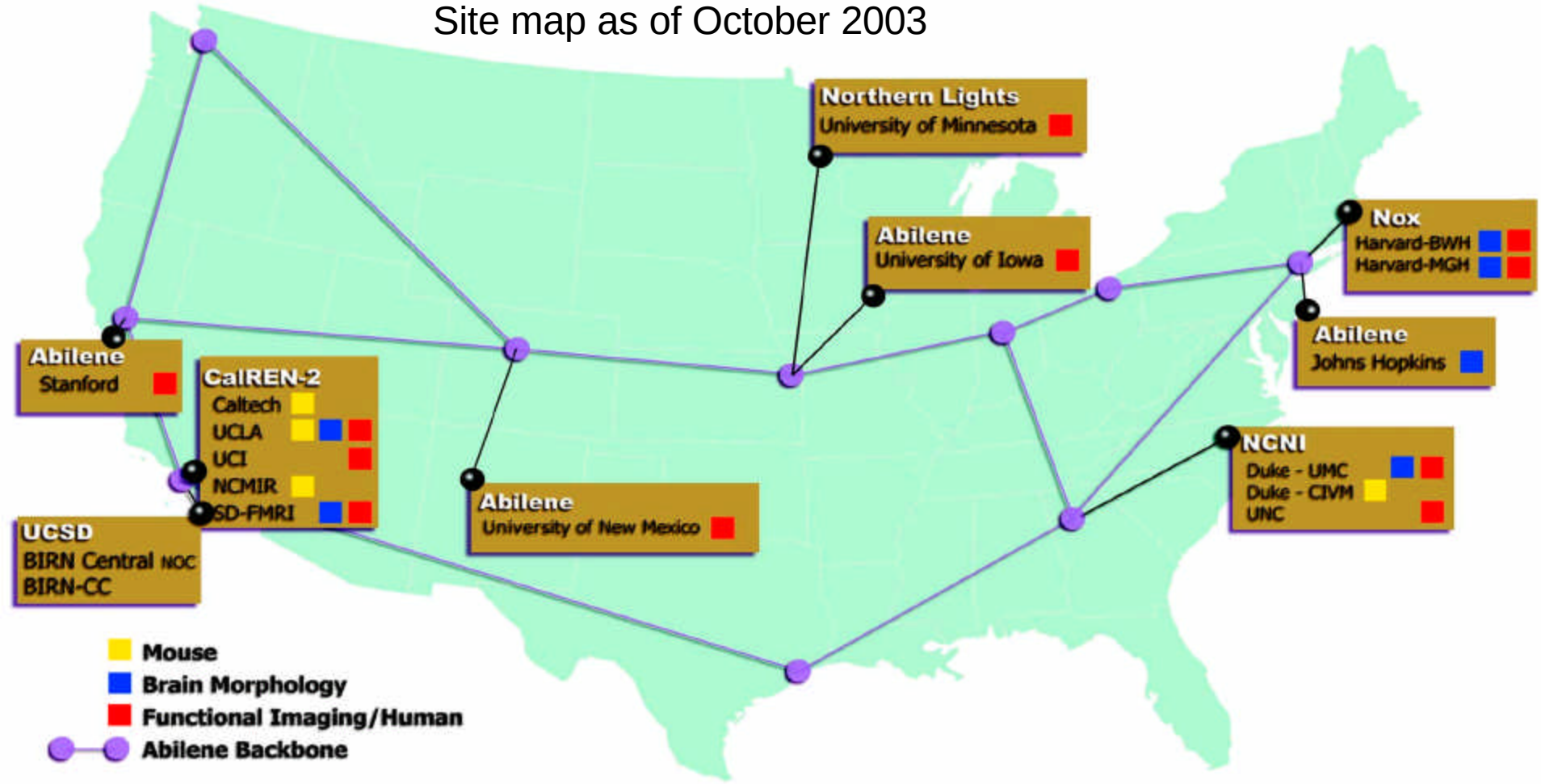
- Integration and interoperability for disparate information sources
  - Large amounts
  - Different formats
  - Raw data, metadata, and derived products
- Analysis
- Spatial and temporal visualization
- Modeling
- Archival and retrieval
- Data continuity, validation, verification
- User requirements that are ALWAYS ahead of the technology development

Biomedical Information Research Network

- Develop solutions to large scale biomedical data sharing and mining and the need to access imaging tools
- Testbeds and a coordinating center
- Create algorithms and other tools that are immediately useful but at the same time are extensible and scalable to other disciplines



Biomedical Informatics Research Network (BIRN)



A shared biomedical IT Infrastructure to hasten the derivation of new understanding and treatment of disease through use of distributed knowledge

Note: It's the only one that seems to be teeming with LIFE!

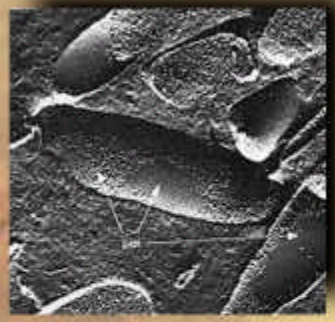
Looking for Life in all the right places

Life in Extreme Environments

Life at the Limits

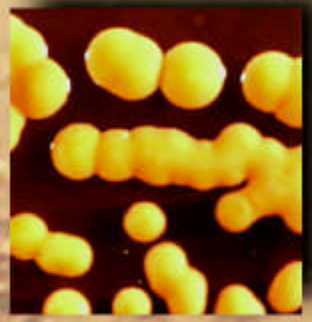
6 Years in Space

5 Megarads

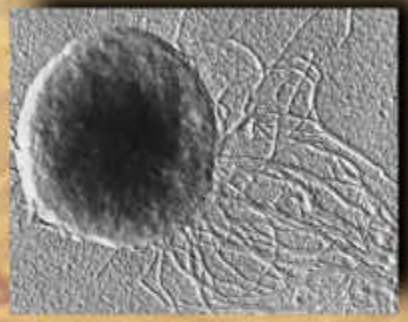


Lives in Salt

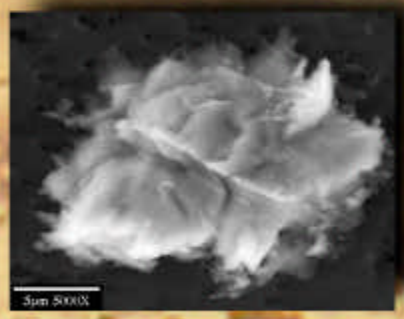
1 Mile Below Surface



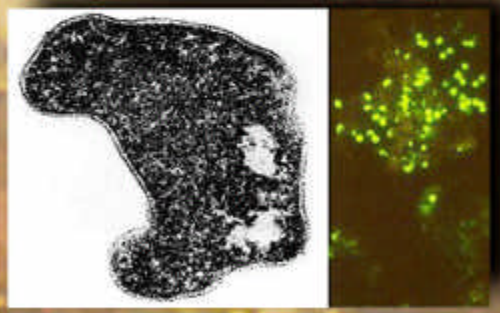
Dormant 25 MY



Deep Sea Vent 2600m

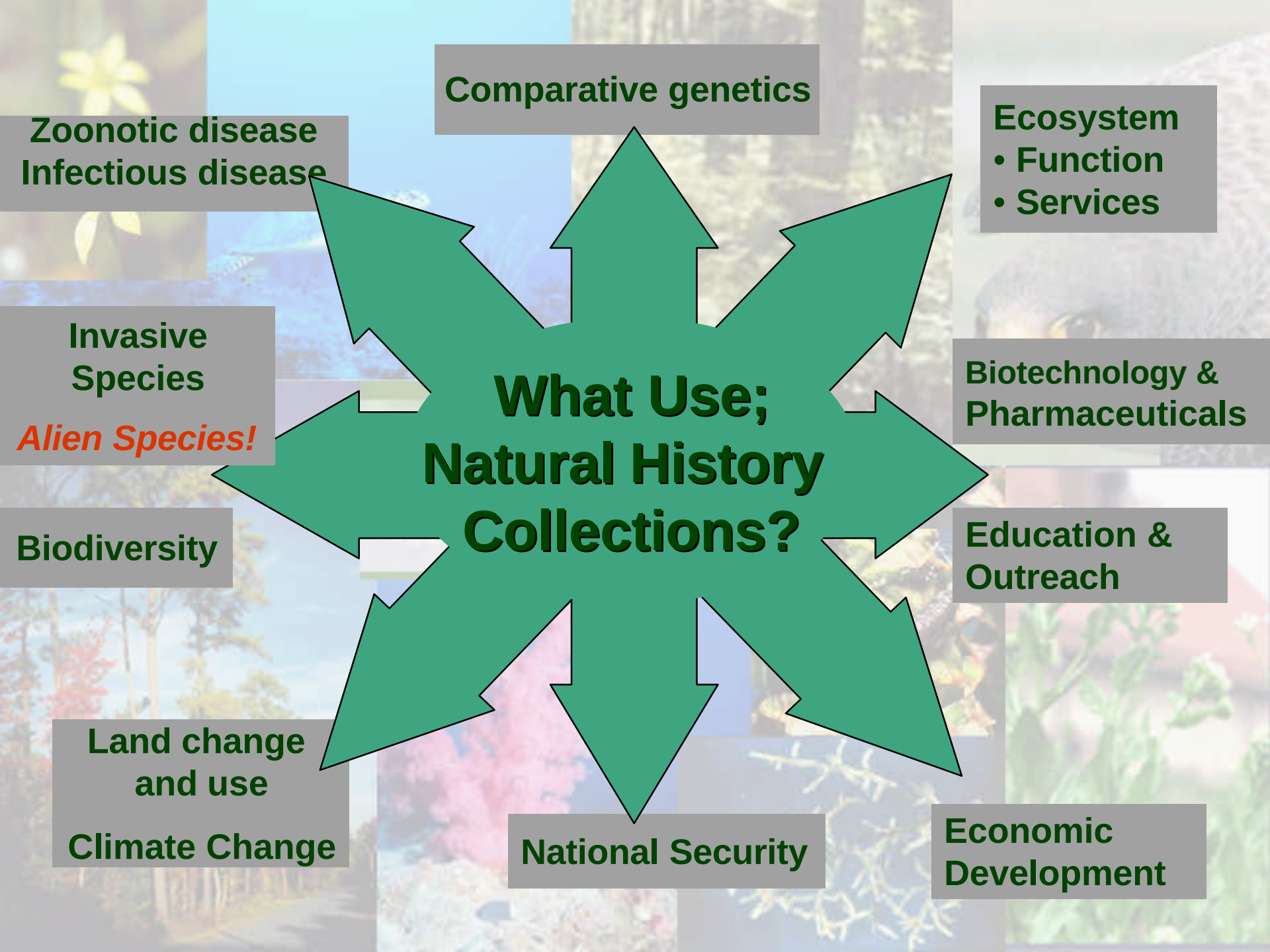


Vostok Deep Ice Core



95C

Battery Acid Cave


Comparative genetics
Ecosystem
• Function
• Services
Zoonotic disease
Infectious disease
Invasive Species
Alien Species!
What Use; Natural History Collections?
Biotechnology & Pharmaceuticals
Biodiversity
Education & Outreach
Land change and use
Climate Change
National Security
Economic Development

“The Universe is Boundless and the Discoveries Unlimited”

E. Weiler, Ph.D.
Associate Administrator for Space Science, NASA