



Harnessing the Power of Nanotechnology for Human Health: The NIH/NIEHS Perspective

Sally Tinkle, Ph.D.
National Institute of Environmental Health Sciences



NIH Mission

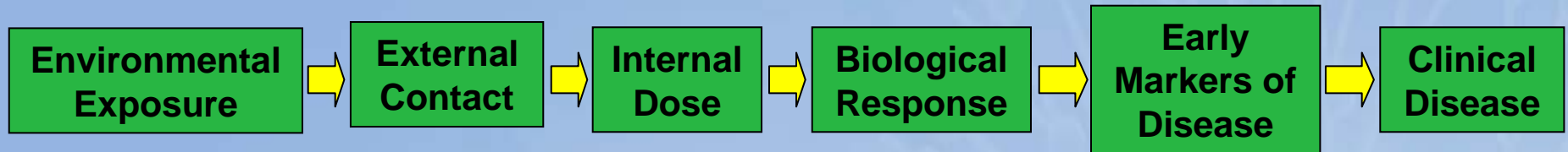
NIH is the steward of
medical and behavioral research for the US.



Science in pursuit of

- fundamental knowledge about the nature and behavior of living systems.
- application of that knowledge to prevent, detect, diagnose, and treat disease and disability.

Research Framework



Adapted from the National Research Council, 1987

Exposure
Routes of Exposure
Biomarkers of Exposure
Fate of Material on Entry

Cellular and Molecular Mechanisms
Biomarkers of Disease/Progression
Imaging and Sensor Technology
Therapeutics

Implications

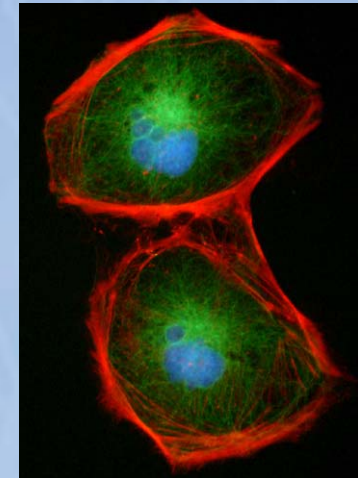
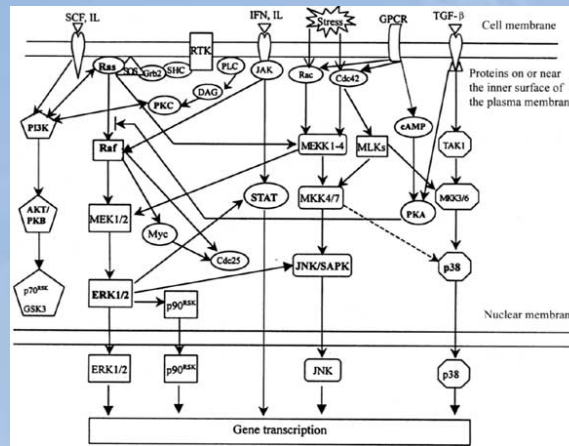
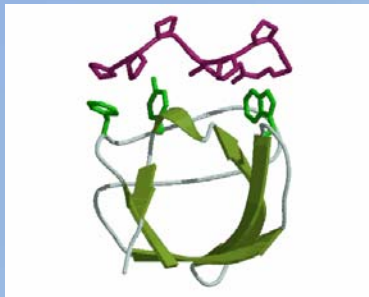
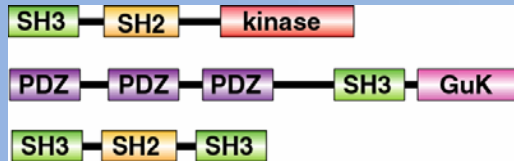
Applications

Interaction of Engineered Nanomaterials with Biological Systems



Harnessing the Power of Nanotechnology for Biology and Medicine

Biological systems as templates for nanoscale and nano-enabled products



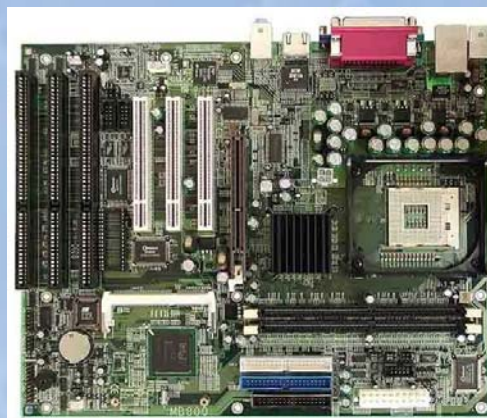
PARTS



DEVICES

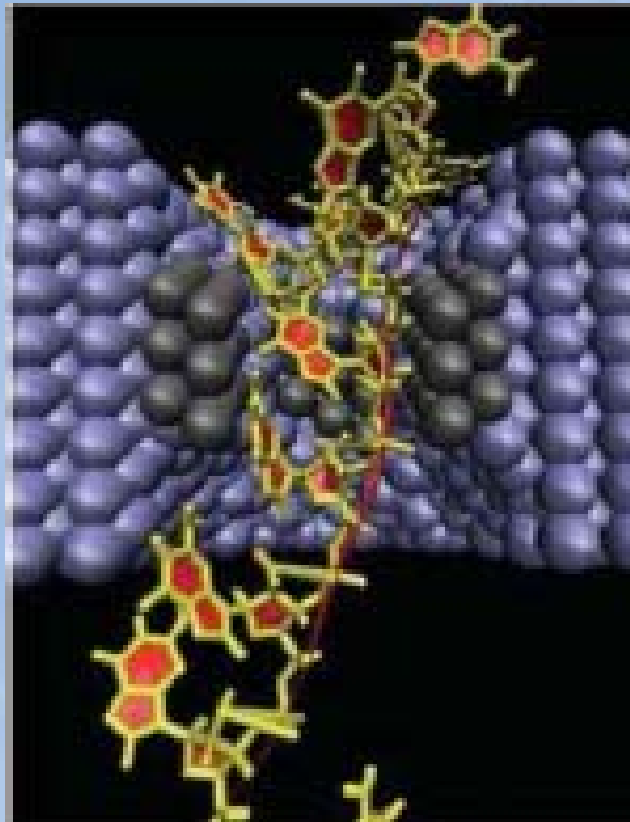


SYSTEMS



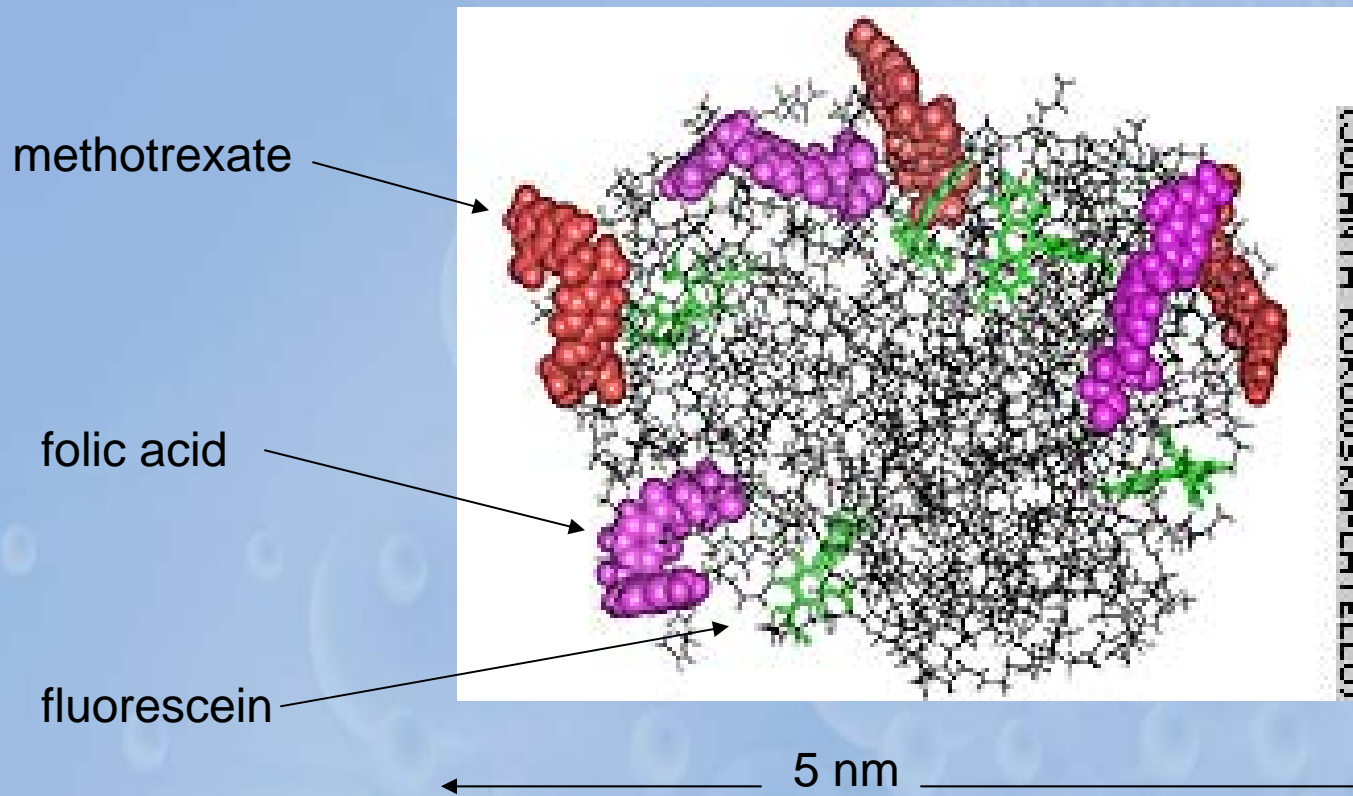
Courtesy of Jeffrey Schloss, Ph.D., NHGRI/NIH

Nanoscale sensors for detection and analysis of biological processes



M. Di Ventra, 2006, Nano Lett. 6:779-782

Multi-functional nanoscale structures for diagnostics and therapeutics

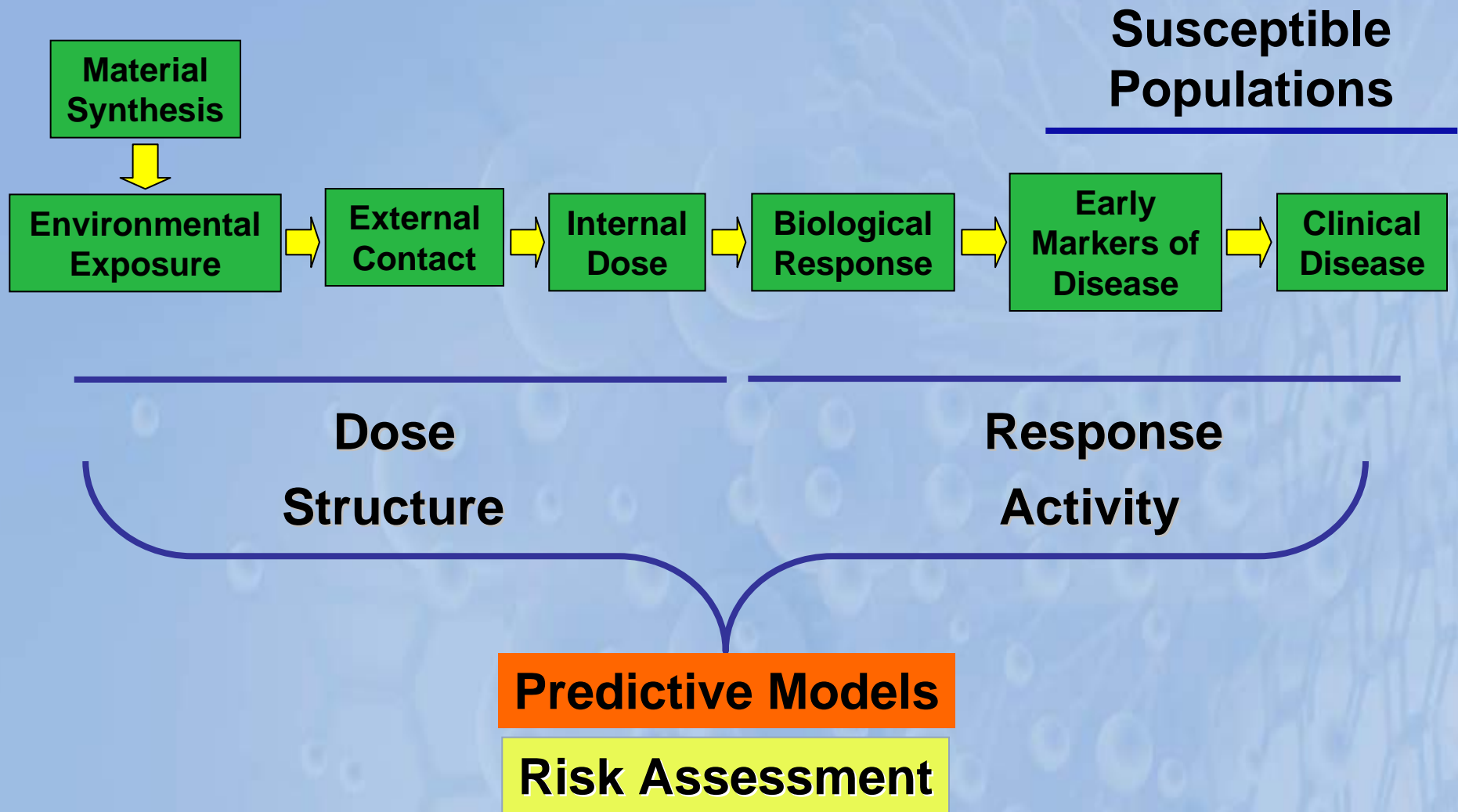


Jolanta F. Kukowska-Latallo, et al., *Cancer Research* 65, 5317-5324, June 15, 2005

The background is a light blue gradient with faint, stylized molecular or network structures. These structures consist of small circular nodes connected by thin lines, resembling a complex lattice or a biological network. The overall aesthetic is clean and scientific.

Harnessing the Power of Nanotechnology to Minimize Risk

Translating the Research Framework to Nanotechnology





Integrating the Science and the Framework

Implications

Applications

**Interaction of Engineered Nanomaterials with
Biological Systems**

Structure

Activity

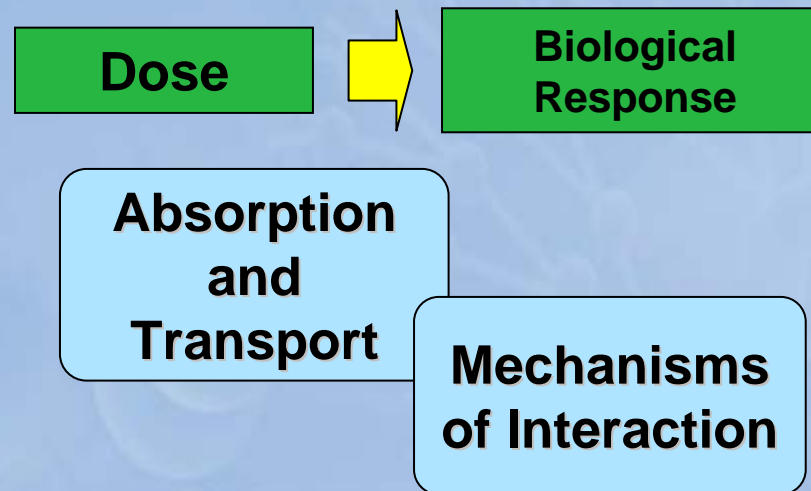
Predictive Models

Risk Assessment

Traditional Extramural Research Mechanisms with Improved Federal Agency Cooperation

**RFA:
Fundamental
Interactions in
Biological Systems**

**Partners:
5 NIH Institutes,
EPA, NIOSH, NSF**



**e.g., Membrane dynamics
Systemic transport
Subcellular localization
Phenotypes**

The background of the slide is a light blue color with a faint, repeating pattern of microscopic or biological structures. These structures include various shapes such as spheres, elongated forms, and branching patterns, resembling cells or molecular models. The overall aesthetic is clean and scientific.

**Is This Getting Us Where
We Need to Go?**



Taking the Next Steps...

- Build on the NIH investment and core competencies
- Pool expertise across government, industry and academia to pursue the very best science
- Target questions within a shared research strategy
- Leverage investment for research efficiencies
- Consistent with US goals for safe commercialization and innovation

...Building the NanoHealth Enterprise



NanoHealth Initiative: Research Themes for the NanoHealth Enterprise

Materials Science Research

- **characterization** of the physical and chemical properties of ENM in relevant biological systems;

Basic Biology Research

- determination of the relationship of nanoscale size and physicochemical properties to **biological response** at the cellular, molecular and systemic levels;

Pathobiology Research

- investigation of the relationship of nanoscale size and physicochemical properties to ENM-induced **pathophysiologic endpoints** and the development of disease;

Informatics Resource (NIBIB)

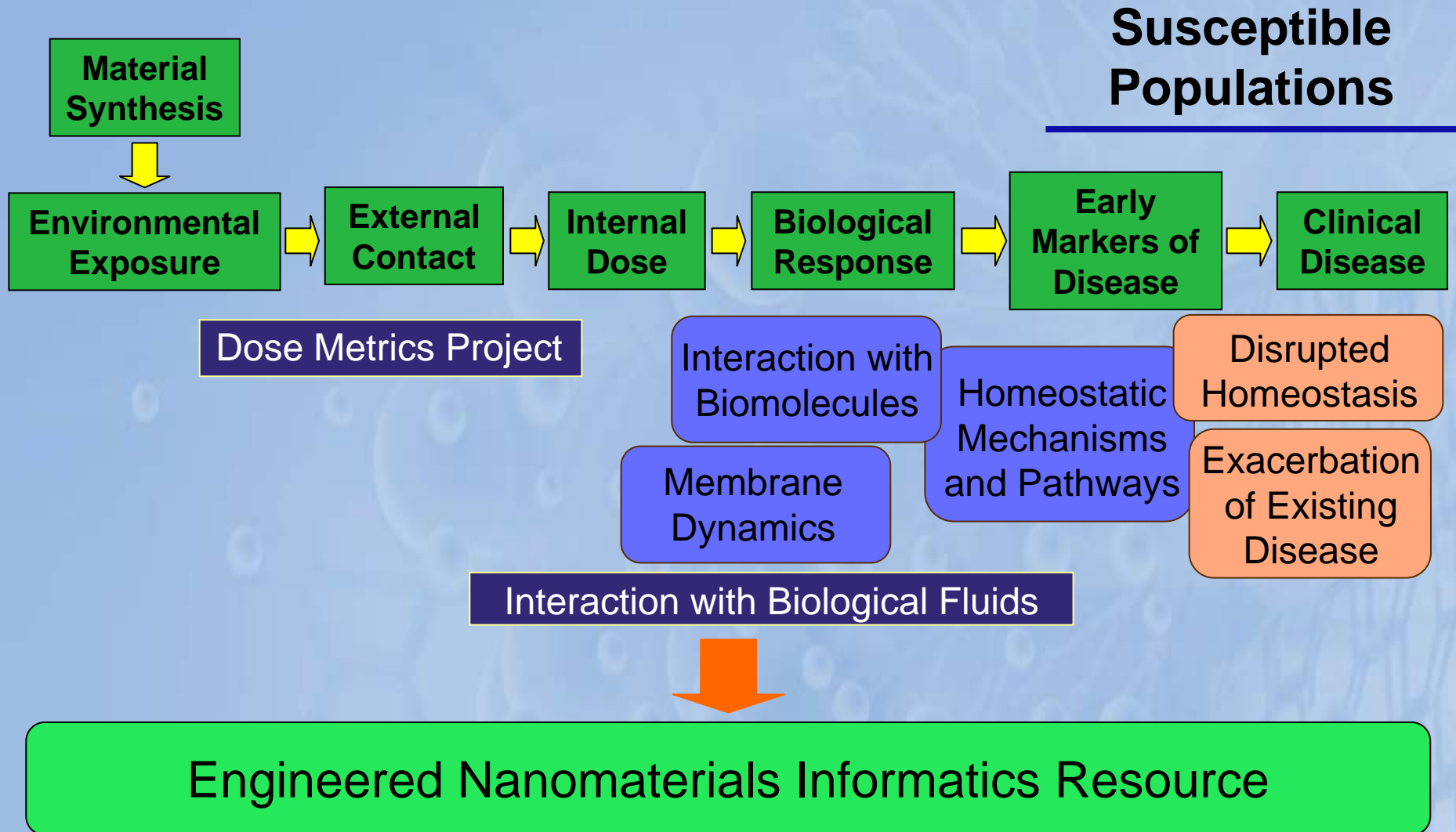
- **collection and organization** of ENM data to facilitate data sharing and data mining to discover structure-function relationships; and

Training Program

- education of scientists to work on **cross-disciplinary and interdisciplinary research teams**, and to develop research programs that integrate materials science, biology, and pathobiology research.



Targeted and Exploratory Research Questions with Basic Biology Answers





Expanding the Definition of Research Products

Biologically and clinically relevant design principles

Curated data sharing framework

Network of research partners

Strategic product design and development

Shorter time from concept to manufacture

Data for hazard identification

Standards setting

Scientific Foundation of an Emerging Science

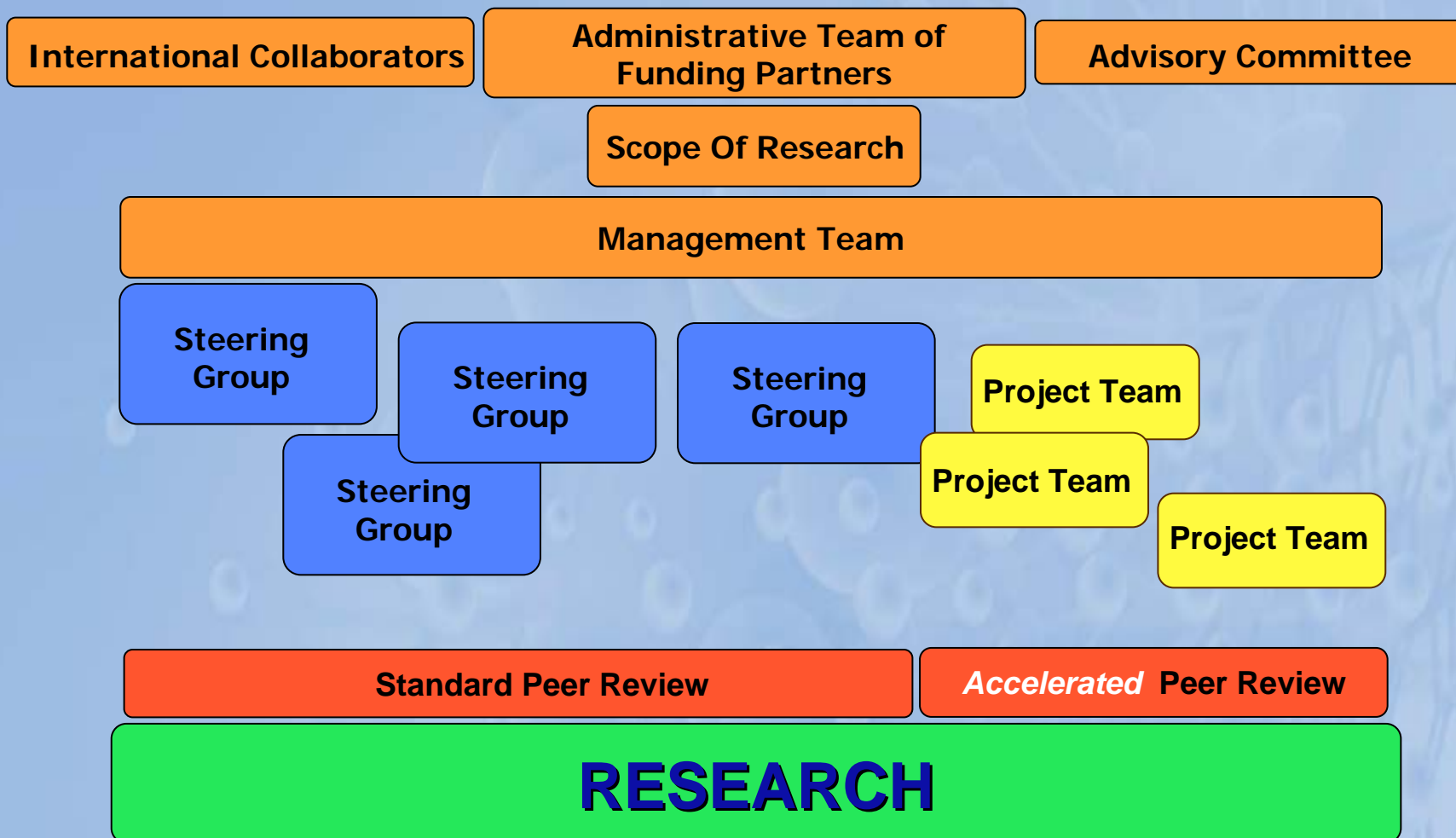


Public-Private Partnerships: Expanding the Way We Do the Business of Research

- **Leverage scientific expertise and funding**
- **Promote dialogue and coordinated effort**
- **Accelerate high priority projects by packaging and procuring services in new ways**
- **Facilitate delivery of technology developed by private entities**
- **Bring collaborative, entrepreneurial approach to large and complex problems and programs**



Flexible and Modular Mechanisms Shared Leadership





Building the NanoHealth Enterprise

**Contact:
Sally Tinkle**

**tinkle@niehs.nih.gov
919.541.0993**

